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IDENTIFIERS Military Curriculum Project

ABSTRACT

This program on instruction and programmed student texts for a secondary-postsecondary-level computer system operator course are one of a number of military-developed curriculum packages selected for adaptation to vocational instruction and curriculum development in a civilian setting. Purpose stated for the ten-lesson course is to provide the necessary information to perform all steps that are required to prepare a job for processing on a computer system. The plan of instruction gives objectives and references for these lessons: Introduction to Data Processing; Punch Card Input and Output; Input and Output Printers; Magnetic Tape Input and Output; Magnetic Disk Input and Output; Channels, Control Units and Physical Addresses; Job Control Language; Concepts in Computer Processing; Application Programs; and Data Representation. The programmed student texts for each topic present all or some of the following information for each lesson: an introduction, objectives, training aids, training material, and self-evaluation (review exercises) with answers. (YLB)

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ED183824

Military Curricula for Vocational & Technical Education

CE 024 383

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

COMPUTER SYSTEM OPERATION

4-3

THE NATIONAL CENTER
FOR RESEARCH IN VOCATIONAL EDUCATION
THE OHIO STATE UNIVERSITY

This military technical training course has been selected and adapted by the Center for Vocational Education for "Trial Implementation of a Model System to Provide Military Curriculum Materials for Use in Vocational and Technical Education," a project sponsored by the Bureau of Occupational and Adult Education, U.S. Department of Health, Education, and Welfare.

MILITARY CURRICULUM MATERIALS

The military-developed curriculum materials in this course package were selected by the National Center for Research in Vocational Education Military Curriculum Project for dissemination to the six regional Curriculum Coordination Centers and other instructional materials agencies. The purpose of disseminating these courses was to make curriculum materials developed by the military more accessible to vocational educators in the civilian setting.

The course materials were acquired, evaluated by project staff and practitioners in the field, and prepared for dissemination. Materials which were specific to the military were deleted copyrighted materials were either omitted or approval for their use was obtained. These course packages contain curriculum resource materials which can be adapted to support vocational instruction and curriculum development.

The National Center Mission Statement

The National Center for Research in Vocational Education's mission is to increase the ability of diverse agencies, institutions, and organizations to solve educational problems relating to individual career planning, preparation, and progression. The National Center fulfills its mission by:

- Generating knowledge through research
- Developing educational programs and products
- Evaluating individual program needs and outcomes
- Installing educational programs and products
- Operating information systems and services
- Conducting leadership development and training programs

FOR FURTHER INFORMATION ABOUT
Military Curriculum Materials
WRITE OR CALL

Program Information Office
The National Center for Research in Vocational Education
The Ohio State University
1960 Kenny Road, Columbus, Ohio 43210
Telephone: 614/486-3655 or Toll Free 800/848-4815 within the continental U.S. (except Ohio)

THE NATIONAL CENTER FOR RESEARCH IN VOCATIONAL EDUCATION

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Military Curriculum Materials for Vocational and Technical Education

Information and Field Services Division

The National Center for Research in Vocational Education

Military Curriculum Materials Dissemination Is . . .

an activity to increase the accessibility of military-developed curriculum materials to vocational and technical educators.

This project, funded by the U.S. Office of Education, includes the identification and acquisition of curriculum materials in print form from the Coast Guard, Air Force, Army, Marine Corps and Navy.

Access to military curriculum materials is provided through a "Joint Memorandum of Understanding" between the U.S. Office of Education and the Department of Defense.

The acquired materials are reviewed by staff and subject matter specialists, and courses deemed applicable to vocational and technical education are selected for dissemination.

The National Center for Research in Vocational Education is the U.S. Office of Education's designated representative to acquire the materials and conduct the project activities.

Project Staff:

Wesley E. Budke, Ph.D., Director
National Center Clearinghouse

Shirley A. Chase, Ph.D.
Project Director

What Materials Are Available?

One hundred twenty courses on microfiche (thirteen in paper form) and descriptions of each have been provided to the vocational Curriculum Coordination Centers and other instructional materials agencies for dissemination.

Course materials include programmed instruction, curriculum outlines, instructor guides, student workbooks and technical manuals.

The 120 courses represent the following sixteen vocational subject areas:

- Agriculture
- Aviation
- Building & Construction Trades
- Clerical Occupations
- Communications
- Drafting
- Electronics
- Engine Mechanics
- Food Service
- Health
- Heating & Air Conditioning
- Machine Shop
- Management & Supervision
- Meteorology & Navigation
- Photography
- Public Service

The number of courses and the subject areas represented will expand as additional materials with application to vocational and technical education are identified and selected for dissemination.

How Can These Materials Be Obtained?

Contact the Curriculum Coordination Center in your region for information on obtaining materials (e.g., availability and cost). They will respond to your request directly or refer you to an instructional materials agency closer to you.

CURRICULUM COORDINATION CENTERS

EAST CENTRAL
Rebecca S. Douglass
Director
100 North First Street
Springfield, IL 62777
217/782-0759

NORTHWEST
William Daniels
Director
Building 17
Airdustrial Park
Olympia, WA 98504
206/753-0379

MIDWEST
Robert Patton
Director
1515 West Sixth Ave.
Stillwater, OK 74704
405/377-2000

SOUTHEAST
James F. Shill, Ph.D.
Director
Mississippi State University
Drawer DX
Mississippi State, MS 39762
601/325-2510

NORTHEAST
Joseph F. Kelly, Ph.D.
Director
225 West State Street
Trenton, NJ 08625
609/292-6562

WESTERN
Lawrence F. H. Zane, Ph.D.
Director
1776 University Ave.
Honolulu, HI 96822
808/948-7834

COMPUTER SYSTEM OPERATOR COURSE

Classroom Course 4-3

531-74D10

Developed by:
United States Army

Development and Review Dates:
March 1979

Occupational Area:
Clerical Occupations

Target Audiences:
Grade 11 - Adult

Print Pages: 228
Microfiche: 4

Availability:
Vocational Curriculum Coordination Centers

Contents:	Type of Materials:							Instructional Design:				Type of Instruction:		
	Lesson Plans:	Programmed Text:	Student Workbook:	Handouts:	Text Materials:	Audio-Visuals:		Performance Objectives:	Tests:	Review Exercises:	Additional Materials Required:	Group Instruction:	Individualized:	
Concepts in Computer Processing	•	•			x			•		•		•	•	

X Materials are recommended but not provided.

THE NATIONAL CENTER FOR RESEARCH IN VOCATIONAL EDUCATION
OSU The Ohio State University
1960 Kenny Road
Columbus, Ohio 432
(614) 486-3655

Course Description:

This course is designed to provide the necessary information to perform all steps that are required to prepare a job for processing on a computer system. The course consists of 15 lessons requiring 37 hours of instruction.

Introduction to Data Processing (2 hours)
Punch Card Input and Output (4 hours)
Printers (3 hours)
Magnetic Tape Input and Output (2 hours)
Magnetic Disk Input and Output (2 hours)
Central Processing Unit (2 hours)
Channels, Control Units, and Physical Addresses (2 hours)
Job Control Language (3 hours)
Concepts in Computer PRocessing (2 hours)
Review Computer Processing (1 hour)
Computer Processing Exam (1 hour)
Critique Computer Processing Exam (1 hour)
Computer Processing CRT Exercise (2 hours)
Computer Job Preparation (7 hours)
Computer Job Preparation Exam (3 hours)

The course contains both student and teacher materials. Printed instructor materials include a program of instruction detailing objectives, and references. Programmed student texts with review exercies and answers are included for each topic area.

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UNITED STATES ARMY INSTITUTE OF ADMINISTRATION
Fort Benjamin Harrison, Indiana 46216

PROGRAM OF INSTRUCTION

FOR

531- 74D10

COMPUTER SYSTEM OPERATOR COURSE

MOS: 74D10

Length: Peacetime: 5 Weeks, 1 day
Mobilization: 4 Weeks, 2 day

This POI supersedes ITP (UNDATED) for the
Computer/Machine Operator Course

121-012-1400-190-A

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Section IV - Annexes

Annex A - Concepts in Computer Processing

Purpose: To provide the student with a working knowledge of the operating characteristics and principles of a Central Processing Unit, channels, control units, and Input, Output and Input/Output media and devices that are included in a complete computer system configuration. To give the student the necessary information to provide and perform all the steps that are required to prepare a job for processing on a computer system.

INTRODUCTION TO DATA PROCESSING

DP-5K-A-10

Hours 2 U 1C 1D

Objective: The student will identify types of computers, and select the elements and components of a computer system.

Tasks Supported: 2.3,

References: Modern Computer Concepts IBM 360 Series/Edward J. Laurie

PUNCH CARD INPUT AND OUTPUT

DP-5K-A-21

Hours 4 U 2C, 2PE2

Objectives: The student will identify the characteristics of punched cards and list the proper handling and storage procedures for punch card input/out, types of card damages to computer cards, and error conditions on input/output devices.

Tasks Supported: 1.12, 1.13, 1.14, 1.15, 1.16, 1.29, 1.30, 2.3

References: IBM System 360 DOS Operation Training Manual
IBM System 360 DOS Training Manual, Book of Illustration
Data Processing Activities, Mgt Procedures and Standards
AR 18-7
Soldiers Manual - FM 12-74D 1/2
TC 12-71-50 PT The 80 Column General Purpose Card

NOTE: SECTIONS I to III HAVE BEEN DELETED DUE TO MILITARY SPECIFIC MATERIAL.

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PRINTERS

DP-5K-A-22

Hours 3 U 3C

Objective: The student will identify the characteristics of computer printers, forms, carriage control, printer errors, and the operator's responsibility in regards to computer printer and form storage requirements.

Tasks Supported: 1.17, 2.3, 2.10

References:
- Printers, Irving L. Nieselman, Data Products, pp 52-70, Mini-Micro System, Jan 78 (Monthly)
- Business Data Processing, 4th Ed., 1975, Prentice-Hall, By Elias M. Awad, Englewood, NJ
- AR 18-7

MAGNETIC TAPE INPUT AND OUTPUT

DP-5K-A-23

Hours 2 U 1C 1PE2

Objectives: The student will identify the characteristics, and the proper care and handling procedures of Magnetic Tape Input and Output.

Tasks Supported: 1.22, 1.31, 1.32, 1.35, 2.2, 2.3, 2.6

References: Business Data Processing, Elias M. Awad, Prentice Hall Inc, Fourth Edition

4

MAGNETIC DISK INPUT & OUTPUT

DP-5K-A-24

Hours 2 U 2C

Objective: The student will identify the characteristics of Magnetic Disk, and the environmental conditions that effect the recording capabilities of magnetic disk.

Tasks Supported: 1.35, 2.2, 2.3

References: Modern Computer Concepts
Introduction to Data Processing
Business Data Processing

THE CENTRAL PROCESSING UNIT

DP-5K-A-25

Hours 2 U 1C 1PE2

Objective: The student will identify the elements, characteristics and functions of the Central Processing Unit.

Tasks Supported: 1.36, 2.6, 2.14

References: Locally prepared materials
Modern Computer Concepts
Introduction to DP, Crawford
Business Data Processing, Awad,
Introduction to DP, Pringale

CHANNELS, CONTROL UNITS AND PHYSICAL ADDRESSES

DP-5K-A-26

Hours 2 U 2C

Objective: The student will identify the functions and characteristics of channels, interface control units and physical addresses.

Tasks Supported: 1.35, 2.4, 2.9

References: IBM Programed Instruction Course R29-9256-2
IBM Introduction to IBM Data Processing System (GC20-1684-3)

JOB CONTROL LANGUAGE

DP-5K-A-32

Hours 3 U 1C 2PE2

Objective: The student will identify the steps of program development and the characteristics and functions of file names, logical units, program libraries, program messages and control cards. The student will identify the functions of job control language statements.

Tasks Supported: 1.12, 1.29, 1.35, 2.9

References: DOS Job Control for Assembler Programers
DOS Job Control for COBOL Programers
IBM DOS Basic Operator Training (Student Text)

CONCEPTS IN COMPUTER PROCESSING

DP-5K-A-33

Hours 2 U 2C

Objective: The student will list the functions of memory area identifiers, memory area priorities, the benefits of disk JCL, the characteristics of job streams, the characteristics of single program and multiprograming processing, and memory distribution.

Tasks Supported: 1.35, 1.36, 2.9

References: Locally prepared materials

REVIEW COMPUTER PROCESSING

DP-5K-A-34

Hours 1 1C

Objective: The student will be able to answer the questions on the Computer Processing Exam (DP-5K-A-35), using the handouts of the previous lessons.

Tasks Supported: 1.35, 2.2, 2.3, 1.36, 2.6, 2.14, 2.4, 2.9, 1.12, 1.29

References: Locally prepared materials.

COMPUTER PROCESSING EXAM

DP-5K-A-35

Hours 1 U 1E

Objective: The student will answer all questions on the Computer Processing Exam.

Tasks Supported: 1.12, 1.29, 1.35, 1.36, 2.2, 2.3, 2.4, 2.6, 2.9, 2.14

References: Locally prepared materials.

CRITIQUE COMPUTER PROCESSING EXAM

DP-5K-A-36

Hours 1 U 1C

Objective: The student will be able to correctly answer those questions previously answered incorrectly by student on Computer Processing Exam (DP-5K-A-37).

Tasks Supported: 1.12, 1.29, 1.35, 1.36, 2.2, 2.3, 2.4, 2.9, 2.14

References: Locally prepared materials.

COMPUTER PROCESSING CRT EXERCISES

DP-5K-A-37

Hours 2 U 2PE1

Objective: The student will select the operating characteristics of input/output media, and devices, functions of channels, control units and physical addresses, functions of JCL, and functions of memory areas.

Tasks Supported: 1.12, 1.13, 1.14, 1.15, 1.16, 1.17, 1.22, 1.29, 1.30, 1.31, 1.35, 1.36, 2.2, 2.3, 2.4, 2.6, 2.9, 2.14

References:

COMPUTER JOB PREPARATION

DP-5K-A-41

Hours 7 U 7PE1

Objective: The student will correctly interpret computer run instructions to determine preparation requirements for processing of job on a computer system. The student will correctly prepare a control and assemble a JCL Dec, and prepare tape labels for a job to be processed on a computer system.

Tasks Supported: 1.12, 1.13, 1.15, 1.17, 1.21, 1.28, 1.29, 1.30, 1.32, 1.35, 2.3, 2.9

References: Locally prepared material.

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COMPUTER JOB PREPARATION EXAM

DP-5K-A-45

Hours 3 U 3E

Objective: The student will interpret a set of computer run instructions and transcribe information from computer run instructions to blank tape labels, prepare a program control card, and insure JCL and deck is complete and accurate.

Tasks Supported: 1.12, 1.13, 1.15, 1.17, 1.21, 1.28, 1.29, 1.30, 1.32, 1.35, 2.3, 2.9.

References: Locally prepared material.

01-01-29

US ARMY INSTITUTE OF ADMINISTRATION
Fort Benjamin Harrison, Indiana 46216

INTRODUCTION TO DP

Prepared for: Computer/Machine Operator Course

Prepared by: Hardware Division, Data Processing Department

March 1979

STUDENT NAME: _____

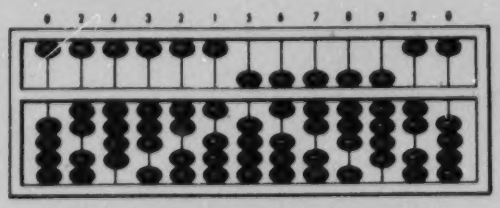
CLASS NO. _____

FOR INSTRUCTIONAL PURPOSES ONLY

Chapter 1
Introduction to DP

A. INTRODUCTION: The concepts of a computer have been in existence for many years. The abacus (See Illustration #1) is a perfect example of how these concepts were used to perform calculations by sliding counters along rods or in grooves to get a numeric total for a given problem. The adding machine serves the same function by providing a numeric total by mechanical means. Adding machines were widely used in record keeping and the preparation of reports in the Army prior to World War II. As the Army grew and more information had to be maintained, a means to process this information (Data) by electrical/mechanical methods had to be adopted. Later as these processing requirements (data processing) increased, electronic computers were introduced into the Army to meet the increased requirements. As a computer operator you will be required to work with an electronic computer.

Illustration #1



Arithmetic is performed on an abacus by moving the appropriate counter beads up or down.

B. OBJECTIVE: The objective of this chapter is to give you the necessary information to:

1. Correctly identify and give the purpose of analog and digital computers; plus, present several examples of each.

2. Differentiate between the three basic elements of a computer system.

3. Correctly identify the five functional components of a digital computer.

4. Correctly identify those terms that are associated with the physical elements of a data processing system.

C. TRAINING AIDS: The supportive materials needed for this chapter: None.

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Illustration #2

23

1.2A

01-01-29

D. TRAINING:

1. Analog and Digital Computers: There are two major kinds of computers, those called analog, and those called digital.

a. The analog computer is used to measure processes which are continuous. The speedometer of an automobile is an example of an analog computer. (See Illustration #2). The speedometer needle has an infinite number of positions that it can take around a graduated dial. The speed measurement is continuous and may not be exact, but it is close enough for the purpose. Other examples of analog computers are the common thermometer, slide rule, scales and the blood pressure cup.

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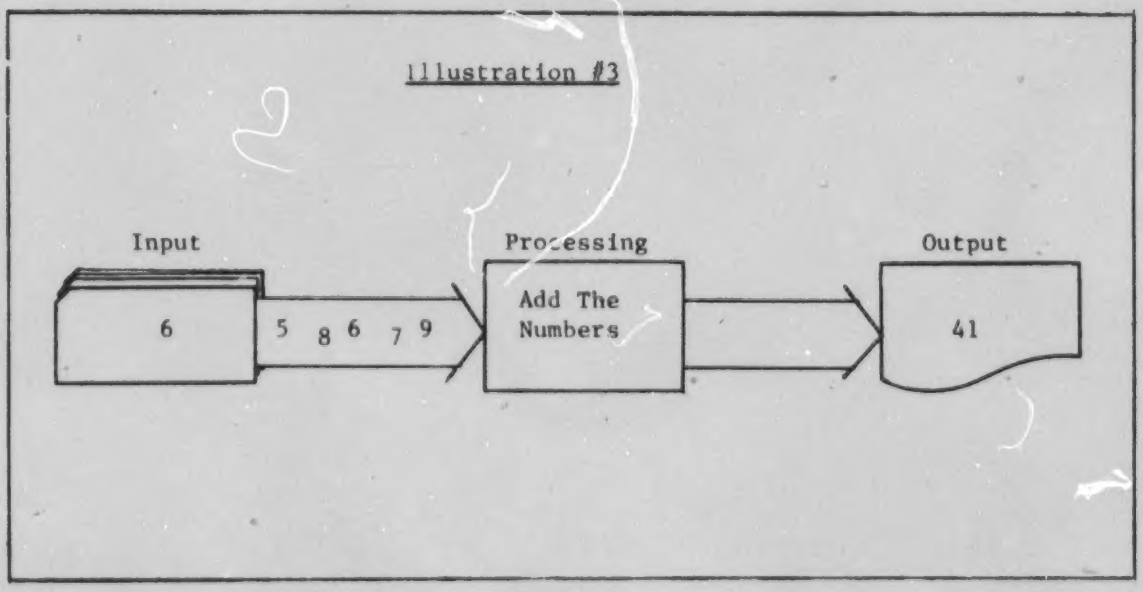
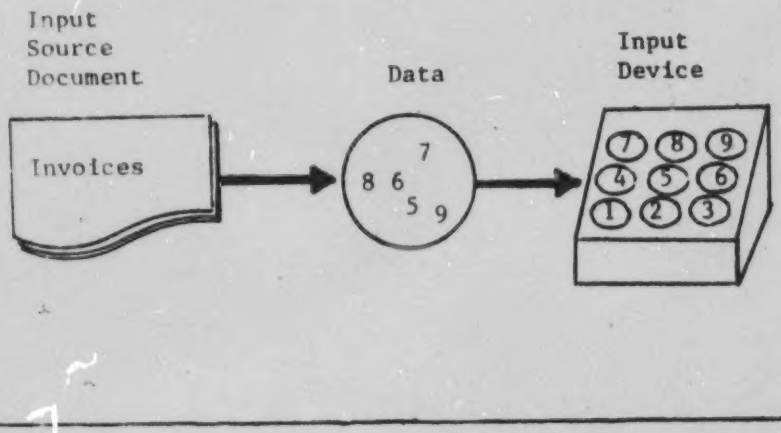
b. The digital computer is more exact and works in graduations or discrete units. The fingers on your hand can be used as an illustration of a digital computer. The main characteristics of digital computers are speed, accuracy, and ability to perform preplanned operations. One of the most significant characteristics of a digital computer is that a series of operations can be planned, and desired results may be obtained with very little human intervention. While analog computers measure and answer the question, "How much?" The digital computer answers the question, "How many?" The digital computer is slower than the analog computer but is much more accurate. The computers used by Army computer operators are almost always the digital type. Digital computers are capable of storing large quantities of data while analog computers normally are not used for storage of data. Now that we have covered the two basic kinds of computers, we are ready to cover the three basic elements of a digital computer.

2. The Three Basic Elements. The three basic elements of any digital computer system, no matter how small or how large it may be are Input, Processing and Output.



a. Input: The term input is used to describe the entry of data and/or instructions into a computer system. The keys (keyboard) on an adding machine are used to feed data into the machine, as a result the keyboard would be described as an input device. On the other hand, the numbers that were keyed into the machine would be considered input data. The document such as the invoice, pay record, or supply requisition, from which the information was gathered for entry into the adding machine is referred to as an input source document (See Illustration #4).

Illustration #4



This information on the source document will not be accepted by the adding machine unless it was converted to a medium that it can interpret. Likewise, a computer system will not accept data until it has been converted to a medium it can interpret. Once this data has been converted, this media will be put into the system by the use of one of several input devices. The type of input media for a computer system depends on the type of input devices that come with the system.

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b. Processing: The manipulation of data within a computer system is called processing. After the data has been converted to an input media and entered into the system through an input device, the data can now be processed to satisfy a predetermined requirement. The type of processing functions done by the computer system is determined by a set of computer instructions (computer program). The Basic Functions of processing are: Classifying, Sorting, Calculating, Editing or Selecting.

(1) Classifying: The term classifying is used to describe the function of assigning a group of related facts (data records) to a given category. An example of this is to classify graduates of the Computer Operator AIT Course as 74D's while graduates of the Infantry AIT Course would be classified as 11B's.

(2) Sorting: Sorting is the arranging of data records in a desired sequence. One example is to arrange the data records of the students in a Computer Operator AIT course in alphabetical order according to their last name.

(3) Calculating: Calculating or computing is another basic function of processing. This is accomplished when the computer adds, subtracts, divides or multiplies data to produce useful results.

(4) Editing: One function of editing is to determine that the input data is correct. An example of this is to make sure that the input data is personnel data rather than equipment data, when the computer is working on a personnel system.

(5) Selecting: Selecting is the processing function of putting from a large amount of data certain data words or items that require special attention. An example of this is selecting computer operator records from a personnel data file to determine how many operators are there.

c. Output: The term output is used to describe the gathering of data from the computer system. In the example of the adding machine, the output of the machine is that display of the numeric total of all the numbers that were added together. The output media in this example would be printed output. The type of output media of a computer system depends on the type of output devices that are connected to the system.

3. Five Functional Components: The five functional components of a digital computer are: input unit, storage unit, control unit, arithmetic/logic unit, output unit.

a. Input Unit: The input unit is that component which performs the function of reading or translating input data into the computer readable language. Once the data has been put on a media that the computer system will accept, an input device, which is part of the input unit, will read the input media into the computer system.

b. Storage Unit: The storage unit of a digital computer is that component which is used to store data or computer instructions. The Storage Unit normally consists of internal and external storage.

(1) Internal Storage: Internal storage is normally used to temporarily hold data and computer instructions for the actual processing of that data. This type of storage resides in the actual computer itself.

(2) External Storage: On the other hand external storage is used to store data or computer instructions outside the computer. The reading or writing of the data and computer instructions to and from this external storage is accomplished through the use of input/output devices.

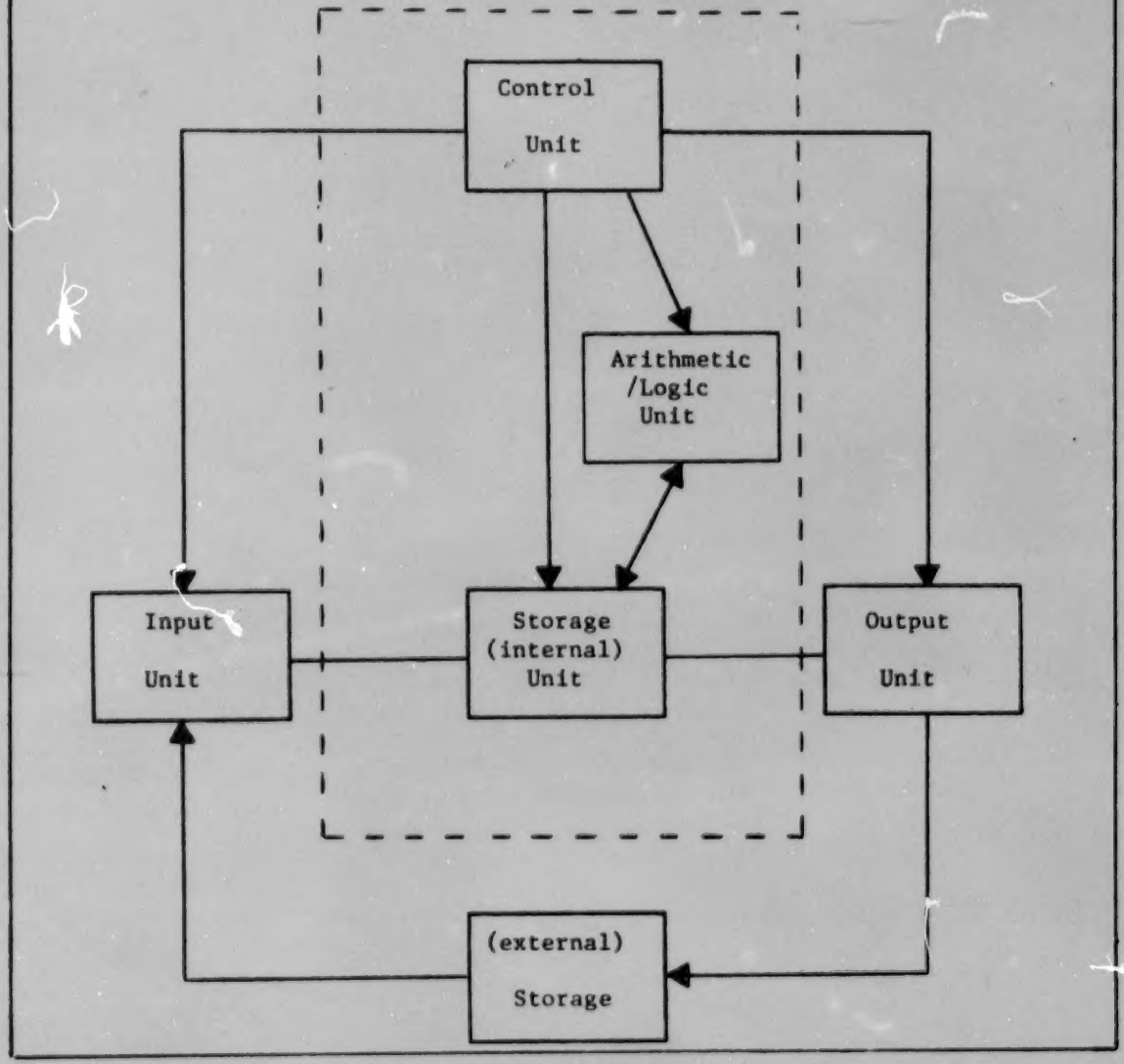
c. Control Unit: The control unit is that functional component which directs the computer in overall performance of operations. This functional component receives from storage an electronic copy of each instruction one at a time in a predetermined sequence. These instructions are interpreted to determine what type of operation is called for, and then the control component activates the necessary electrical impulses to perform that operation. In other words, all computer instructions are executed under the immediate direction of the control component.

d. The Arithmetic/Logic Unit: The arithmetic/logic basic functional component is responsible for the calculation or other manipulation of data. The arithmetic/logic component receives an electronic copy of data from the storage component and performs the arithmetic operations such as addition, subtraction, multiplication and division as well as the logical operations primarily concerned with testing. This ability to test a given condition is the result of programmed computer instructions.

e. The Output Unit: The output unit is that component which performs the function of writing and/or interpreting output data. Once the data has been processed the computer will instruct an output device to generate the output. Output may be considered as modified data or updated information. It may be in machine readable form or it may be in human readable form.

Illustration #5

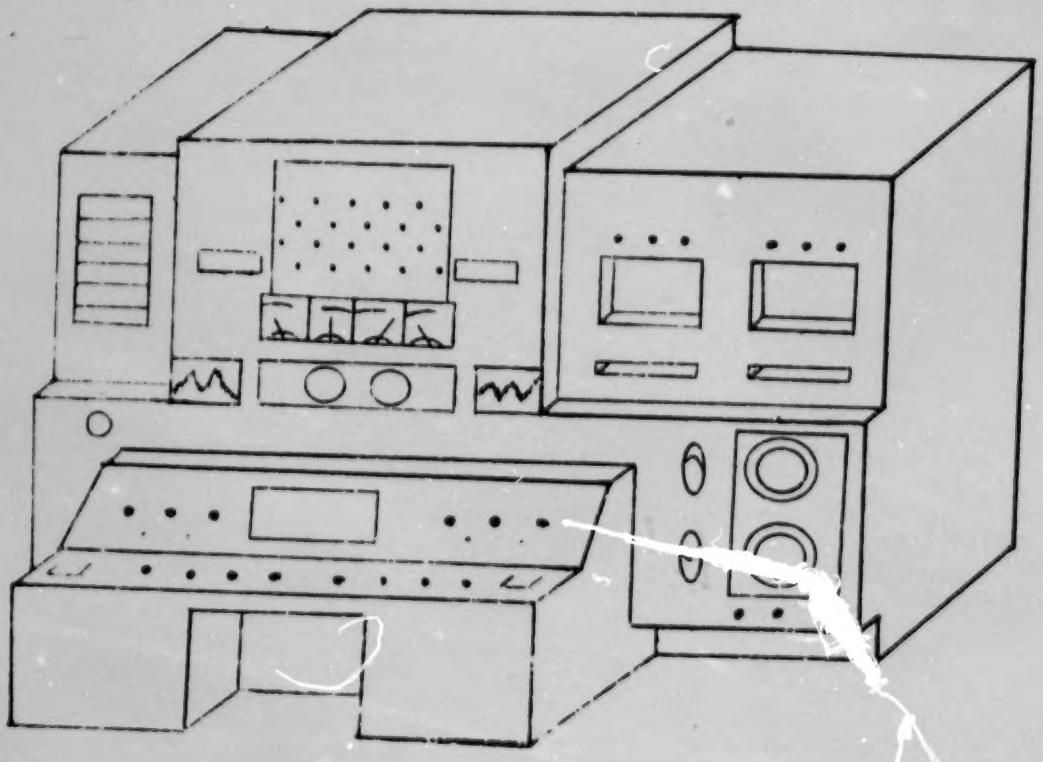
The Five Functional Components



4. Physical Elements: The physical elements of a computer center are hardware, software, and personnel.

a. Hardware: Hardware is the actual nuts and bolts, (See Illustration #6) it is the machinery of an electronic data processing system. Hardware consists of the computer and the input/output devices that are connected to the computer. All this machinery makes up the hardware of a computer center.

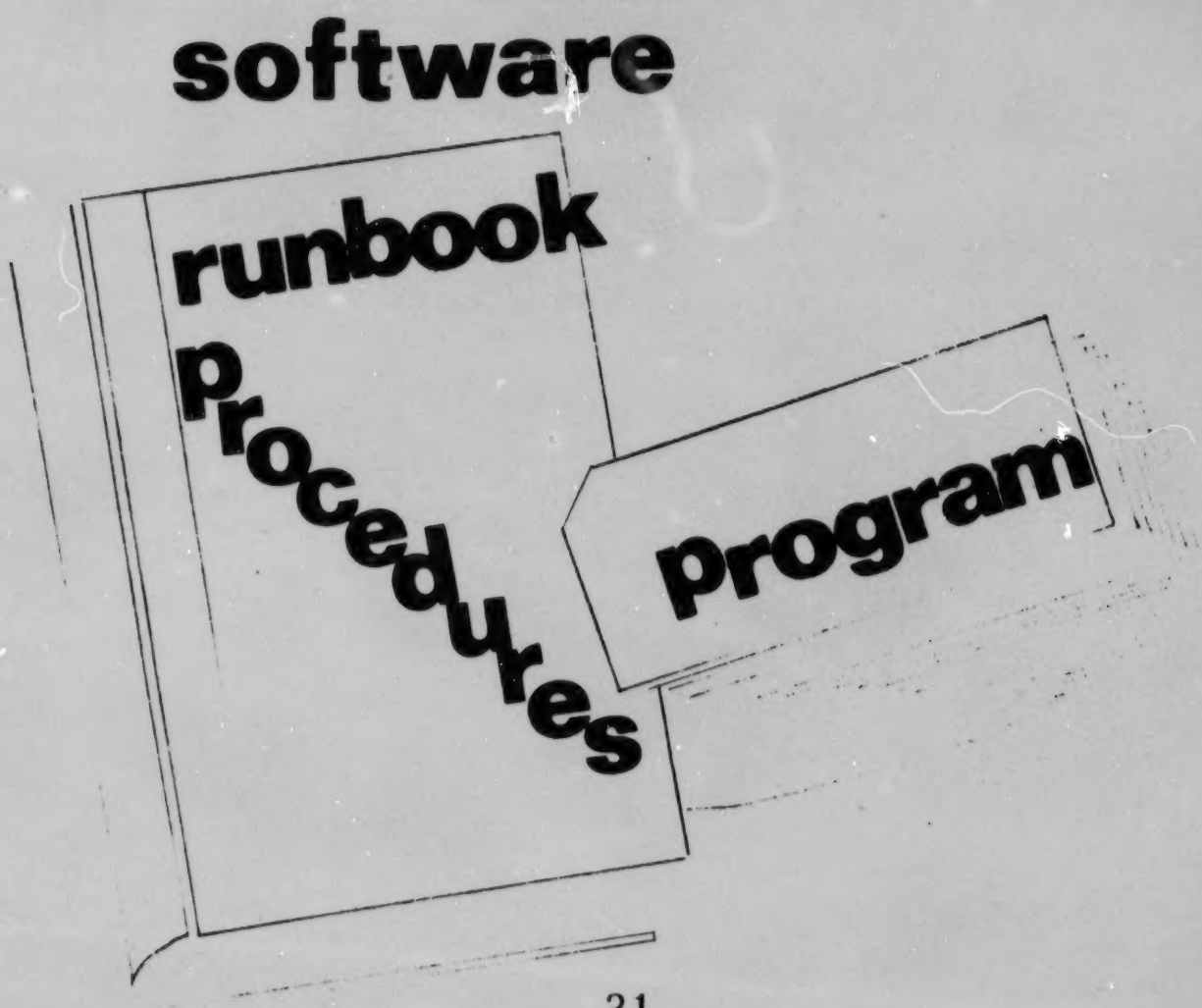
Illustration #6



HARDWARE

b. Software is another physical element of a computer center (See Illustration #7). Software is the procedures and programs found in a computer center. Examples of software are computer systems manuals, computer system documentation and computer instructions (computer programs).

Illustration #7



c. The final physical element of a computer center is its personnel. These are the folks that are responsible for the integrity of the data received, processed, and distributed as output. You as a computer operator will be part of this team of data processing personnel.

Other personnel that you will have some contact with in your installation are:

(1) The Data Processing Installation (DPI) Manager: He is responsible for the overall management of the installation.

(2) Mid-management Supervisors: There will be supervisors for each section of the DPI such as the Programming, Maintenance and Operation Sections.

(3) Programmers: These individuals are responsible for writing computer instructions and maintaining these programs used in the installation.

(4) System Analyst: System Analysts communicate with people in regard to developing programs that meet their needs.

(5) Shift Supervisor: This individual will be your immediate supervisor. He is responsible for the overall operation of the computer room during his shift to include the supervision of the operators.

(6) Computer Scheduler: He is responsible for the scheduling of all processing on the computer system.

(7) Input/Output (I/O) Clerks: You may perform this job in your installation. I/O Clerks perform the function of handling and accounting for all computer input and output in the installation.

(8) Librarian: This is another job you may perform. The Librarian is responsible for maintaining the library information in the installation.

(9) The User: Even though the user may or may not be part of the computer center, without the user the installation would have no purpose. The user is the command or individual that your installation services. The user is the one that uses the results or the processing in his daily management and activities.

E. SUMMARY: During this block of instruction, we have learned the following:

1. The difference in analog and digital computers.

2. The three basic elements of a computer system which are input, processing, and output.

3. The five functional components of a digital computer which are the input unit, storage unit, control unit, arithmetic/logic unit, and output unit.

4. The three physical elements of a data processing system which are hardware, software, and personnel.

F. CONCLUSION: Automatic Data Processing has spread to every phase of Army life. The quality of work you do in the field will affect many people's lives, maybe even your own. Become a professional in your field by starting now to learn all you can about data processing in this course and in the United States Army. Your future depends upon you.

INTRO TO DATA PROCESSING

SELF EVALUATION

Situation: You are in a classroom about to take a Science and Arithmetic test, your instructor gives you the following items to solve the test problems and to record your findings.

A calculator	A question sheet
A thermometer	An answer sheet
A pencil	A paper clip
An eraser	A speedometer

QUESTION 1. Among these items, the examples of an input source document are?

A. Calculator	E. Answer sheet
B. Paper clip	F. Thermometer
C. Question sheet	G. Eraser
D. Pencil	H. Speedometer

QUESTION 2. Among these items, the examples of an analog computer are?

A. Answer sheet	E. Thermometer
B. Question sheet	F. Pencil
C. Paper clip	G. Eraser
D. Speedometer	H. Calculator

QUESTION 3. The five functional components of a digital computer are?

A. Output	E. Arithmetic/logic unit
B. Input unit	F. Output unit
C. Storage unit	G. Control unit
D. Input	H. Processing

QUESTION 4. The three basic elements of a computer system are?

A. Output	E. Output unit
B. Input unit	F. Sorting
C. Storage unit	G. Input
D. Processing	H. Control unit

Question 5. Among these items, the examples of processing are?

A. Sorting	E. Inputing
B. Printing	F. Classifying
C. Calculating	G. Outputing
D. Editing	H. Selecting

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QUESTION 6. Among these items, the personnel physical elements of data processing installation are?

A. Operator
B. Card Reader
C. Disk Drive
D. Librarian
E. Control programs
F. System manuals
G. I/O Clerk
H. Tape Drive

SOLUTIONS

Chapter 1, Introduction to DP

Solution	Reference
1. c	2(a)
2. e, d	1(a)
3. b, c, e, f, g	3
4. a, d, g	2
5. a, c, d, f, h	2(b)
6. a, d, g	4c

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01-02-29

US ARMY INSTITUTE OF ADMINISTRATION
Fort Benjamin Harrison, Indiana 46216

PUNCH CARD INPUT AND OUTPUT

Prepared for: Computer/Machine Operator Course

Prepared by: Hardware Division, Data Processing Department

October 1978

STUDENT NAME: _____

CLASS NO. _____

FOR INSTRUCTIONAL PURPOSES ONLY

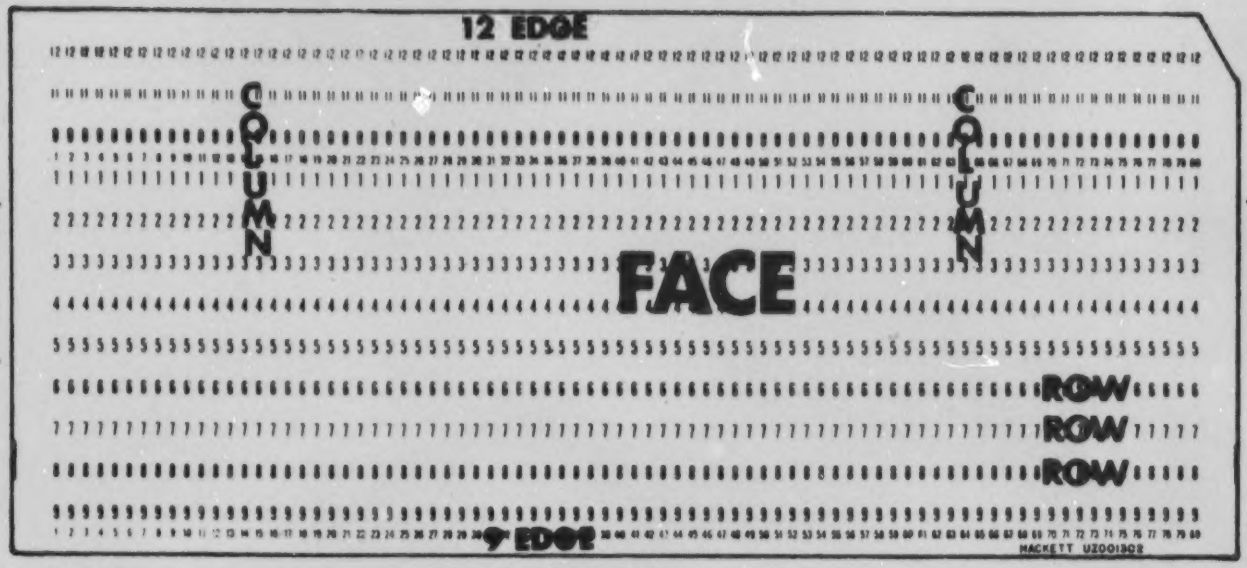
INTRODUCTION

Today, we are continuously exposed to punched cards. We see them in the Government checks we receive, the U.S. Savings Bonds we purchase, and numerous other situations.

These punched cards are read by card readers, and are normally, punched by card punches that are connected to a computer.

Since one way we communicate with the computer is through the media of punched cards, it is essential that each of you are throughly familiar with punched cards.

Along with this knowledge, you must have a basic understanding of some of the equipment used to read and punch these cards.


12 EDGE
COLUMN
COLUMN
1
FACE
80
ROW
ROW
ROW
9 EDGE
MACKETT UZ001302

BACK

1. HISTORY OF PUNCH CARD ACCOUNTING: In 1887 Dr. Herman Hollerith developed a machine to compile and tabulate census statistics by the use of punched paper tape. That code, which is still used on cards today, bears his name. (Hollerith Code)

2. CARD CHARACTERISTICS: See Illustration #1

a. An 80 column card will consist of:

(1) 80 vertical columns across the card.

(2) 12 rows horizontally across the card.

b. Nomenclature: As we speak of the cards, we refer to particular areas of the card by name.

(1) Face: The face of the card is that surface which will normally have printing of some type on it. It is that side that shows the card columns and rows.

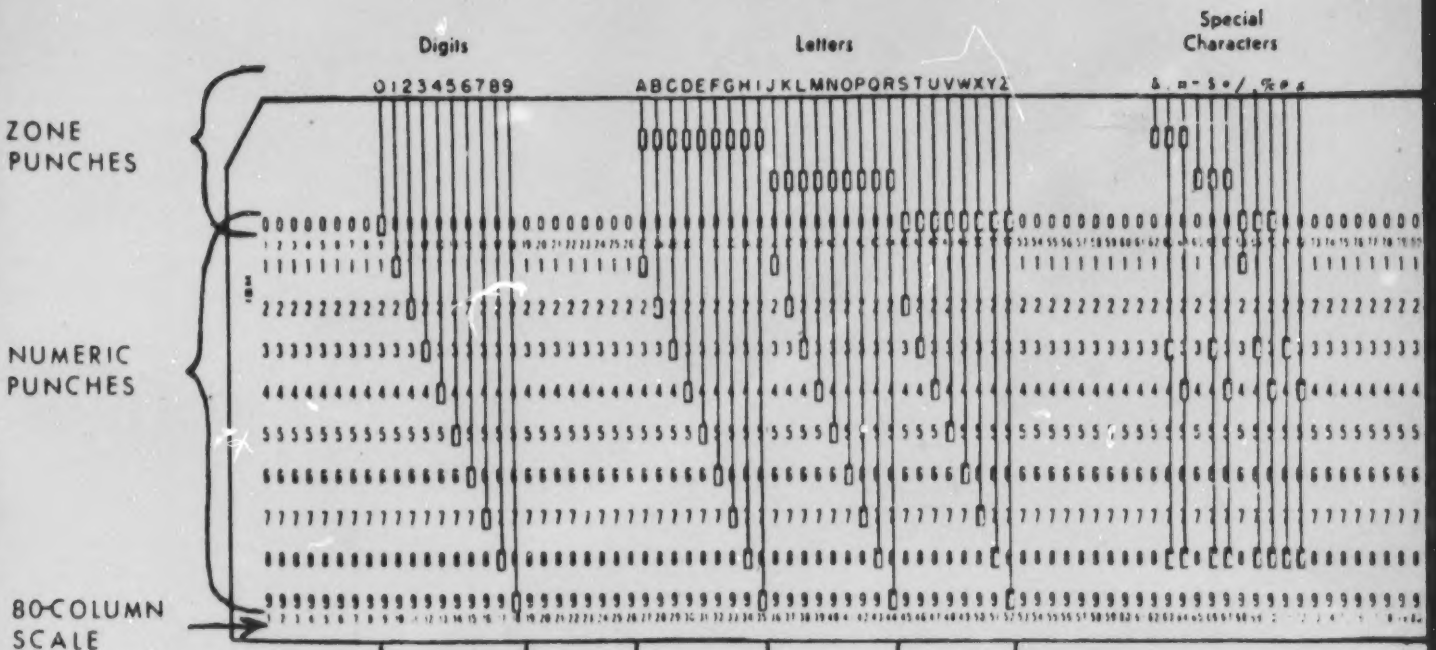
(2) 12 Edge: The top of the card, as we look at it, is nearest the "12" punching position. This edge is therefore referred to as the "12" edge.

(3) 9 Edge: The edge nearest the "9" punching position is referred to as the "9" edge.

(4) 1 Edge: The "1" edge is located nearest card column 1.

(5) 80 Edge: The "80" edge is located nearest card column 80.

PUNCHING SYSTEM FOR AN 80 COLUMN PUNCH CARD


Digits
Letters
Special Characters
0 1 2 3 4 5 6 7 8 9
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
ZONE PUNCHES
NUMERIC PUNCHES
80-COLUMN SCALE

If only a numeric punch is in any column it represents whatever number is punched out

12 Punch AND	11 Punch AND	0 Punch AND
1 - A	1 - J	2 - S
2 - B	2 - K	3 - T
3 - C	3 - L	4 - U
4 - D	4 - M	5 - V
5 - E	5 - N	6 - W
6 - F	6 - O	7 - X
7 - G	7 - P	8 - Y
8 - H	8 - Q	9 - Z
9 - I	9 - R	

Illustration #2

3. TRANSLATING THE PUNCH HOLE COMBINATIONS OF AN 80 COLUMN PUNCHED CARD: See Illustration #2

a. Each card column has 12 punching positions.

(1) A hole in punch position 12 in a card column is called a twelve punch.

(2) A hole punched in position 11 in a card column is called an eleven punch.

(3) A hole in punch position 0 in a card column is called an zero punch. And so on down the card.

b. Numeric Characters: There are ten numeric punching positions starting with the zero row through the nine row.

(1) A punch placed in any of the ten punching positions (0-9) in a card column is called numeric punching. Only one numeric character may be placed in a column. For example: if a hole is punched in the "6" punching position, it is read as a "6" and has the value of "6".

(2) The location of the hole in the card is how the machine recognizes it. We can punch any <u>one</u> of the ten numeric punches in any of the 80 columns in a card.

c. Alphabetic Characters:

(1) The 26 alphabetic characters are created by punching a combination of holes. This combination will consist of a 12, 11, or 0 punch and one of the nine numeric punches 1-9 into the same column. The way this is done, is the alphabetic letters are divided into three groups.

(a) The first 9 letters, A-I are associated with the 12 punch.

(b) The second 9 letters, J-R, are associated with the 11 punch.

(c) The remaining letters, S-Z with the zero punch. A-I (12), J-R (11), S-Z (0)).

(2) The 12 punch and the 1 punch creates the letter A, a 12 punch and the 2 punch creates the letter B and continues in sequence to the 9 punch for the letter I. Then we start with the 11 punch and a 1 punch which creates the letter J, continuing in sequence through 11 punch with a 9 punch to create an R. The 0 punch, and the 2 punch creates the letter S and this is continued in sequence thru 0 punch and a 9 punch for the letter Z. When starting the last 8 letters with 0 punch, the one punch is skipped over because it is so close to the 0 punch.

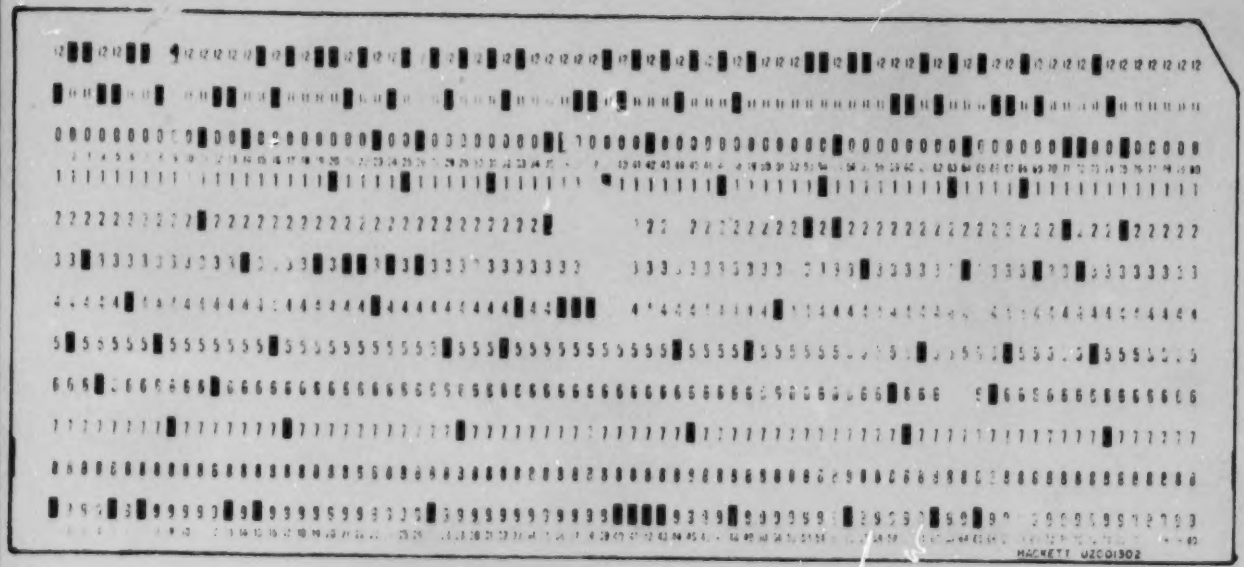
At this time it is necessary to mention that a zero punch is a numeric punch and is usually represented by a 0 with a slash through it: "Ø", and the alphabetic character O is represented by an O with a line under it: "<u>O</u>".

12 Punch and	11 Punch and	0 Punch and
1 = A	1 = J	
2 = B	2 = K	2 = S
3 = C	3 = L	3 = T
4 = D	4 = M	4 = U

5 = E	5 = N	5 = V
6 = F	6 = O	6 = W
7 = G	7 = P	7 = X
8 = H	8 = Q	8 = Y
9 = I	9 = R	9 = Z

d. Special Characters: The 80-column punching system consists of eleven special characters. These characters are created by punching various combinations of punches in a column. For example: the dollars symbol ($), consists of the 11 punch, the 3 punch and an 8 punch. The six special characters which you will be concerned with in this course are:

(1)	(/)	Slash	0 - 1 punch
(2)	(&)	Ampersand	12 punch only
(3)	(*)	Asterisk	11 punch, a 4 punch, and an 8 punch.
(4)	(%)	Percent	Zero punch, a 4 punch, and an 8 punch.
(5)	(,)	Comma	Zero punch, a 3 punch, and an 8 punch.
(6)	(')	Apostrophe	5 punch and an 8 punch


HACKETT UZC01302

Translate the prepunched card on page 8. This will test your ability to translate the Hollerith code. (NOTE: The translation is located at the bottom of page 11.)

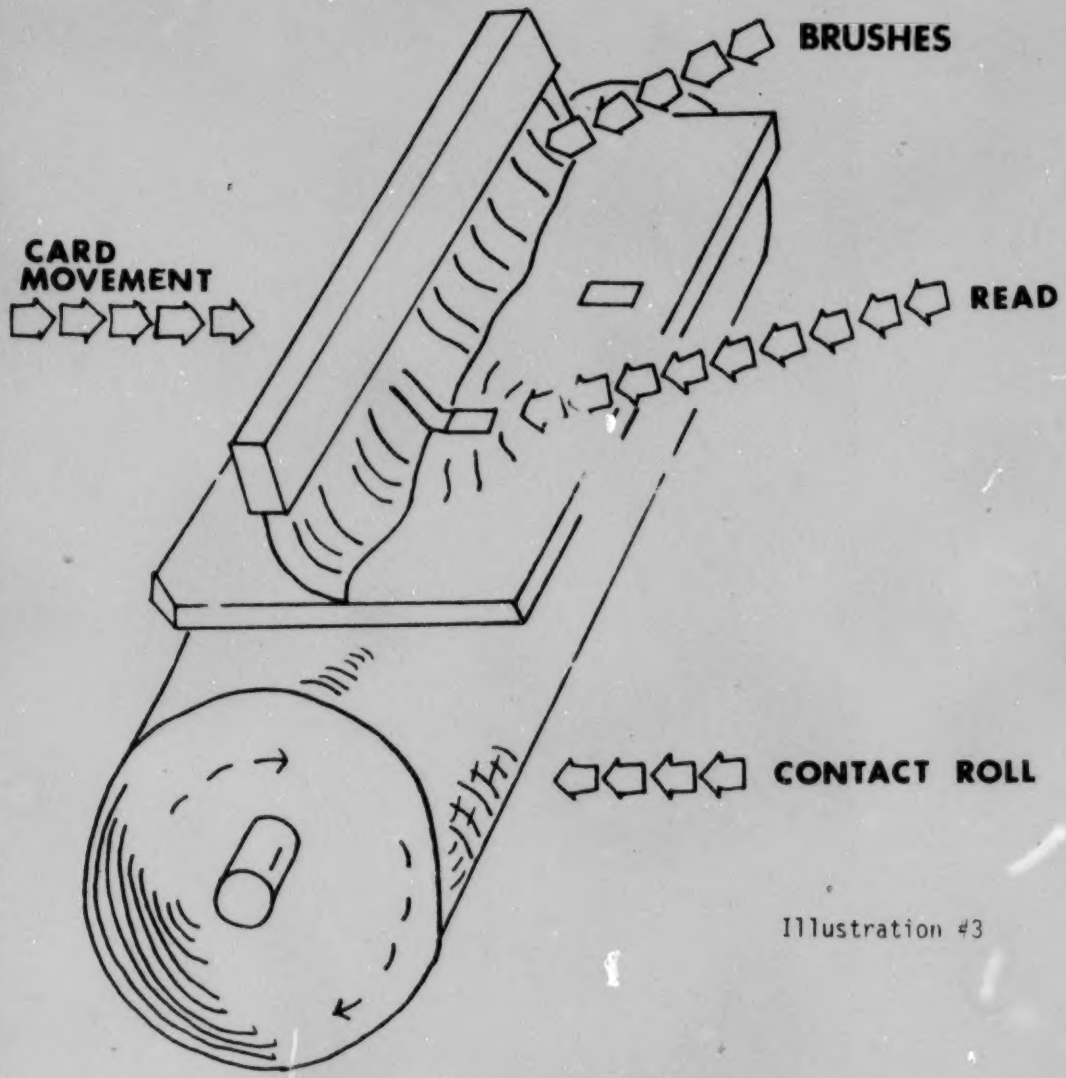


Illustration #3

4. Card Input and Output Equipment: There are two types of punch card devices; card readers and card punches. Some manufacturers have combined both the card reader and punch in the same cabinet.

a. Card Readers

See Illustration #3

(1) Mechanical Card Readers: Cards are mechanically moved from a card hopper, through the card feed unit, and wire sensing brushes read data from the cards by making a charged contact with a metal drum through the holes. This type of card reader has two sets of wire sensing brushes which read the card.

An impulse which is automatically converted from the Hollerith code, into machine language is transmitted to the computer. These mechanical card readers read one row at a time and speeds range from about 200 to 1,000 cards per minute.

(2) Photoelectric Card Readers: These high performance readers use vacuum and belt feeds and photoelectric cells tosense the punches in a card. The cards are read serially by column, thereby reducing the number of photocells required.

As the card is passed under a light source in the card reader, light passing through the punched holes activates the cells and the information is transferred to the computer.

b. Reader Errors:

(1) Read Check

(a) Mechanical Readers: Signals the detection of a hole count check. In other words as the card passes under the first set of ready brushes it takes a count of the holes punched in the card. Places this count in memory and holds it until the second set of read brushes makes its count.

TRANSLATION OF PREPUNCHED CARD ON PAGE 8. - Recording, Sorting, Calculating, and summarizing are 4 basic operational steps.

Then the two counts are compared to see they are the same. If the two counts are not equal then the read check or parity check lights are activated. (Model of equipment depends on whether it is a read check light or a parity check light.)

(b) Photoelectric Card Readers: This is the detection of invalid, off-punched, and mispositioned codes in a card. In other words the proper amount of light from the photoelectric cell could not pass through the hole punched in the card.

(2) Feed Check 3 - A feed check occurs when:

(a) the card fails to be read by the reader.

(b) the card is wedged in the feed hopper.

(3) Validity Check: Indicates that an invalid punch hole combination has been sensed. This is done by checking for more than one punch in rows 1 through 7 of a card.

c. Card Punch: These devices usually have two stations;

(1) Punch station

(2) Punch check station and generally punch one card row at a time with an average speed of 350 cards per minute. The slow movement of the punching dies has generally limited the output speeds of card punches.

(a) Punch Check: Occurs when detection of a hole count error, parity check, addressing error or translate check inthe attached control unit. In other words there was a disagreement in the hole count from the punch station whencompared to the hole count in the punch check station.

(b) Feed Check: Occurs when a card jams within the machine, a misfeed from the card feed hopper, or a punch clutch failure.

5. Handling, Storage, Card Damages and Punching errors.

a. Handling - In handling cards, care should be taken not to tear, mutilate, spindle or staple cards.

b. Storing of card stock: Cards should be kept in a warm, dry place. When storing these cards, they should be stored under pressure in card trays.

New cards should be stored flat in original boxes (2,000 to a container, 10,000 to a box). These boxes should not be stacked more than 3 high and in a criss-cross pattern. This card stock is constructed of high-grade paper in order to withstand repeated machine usage.

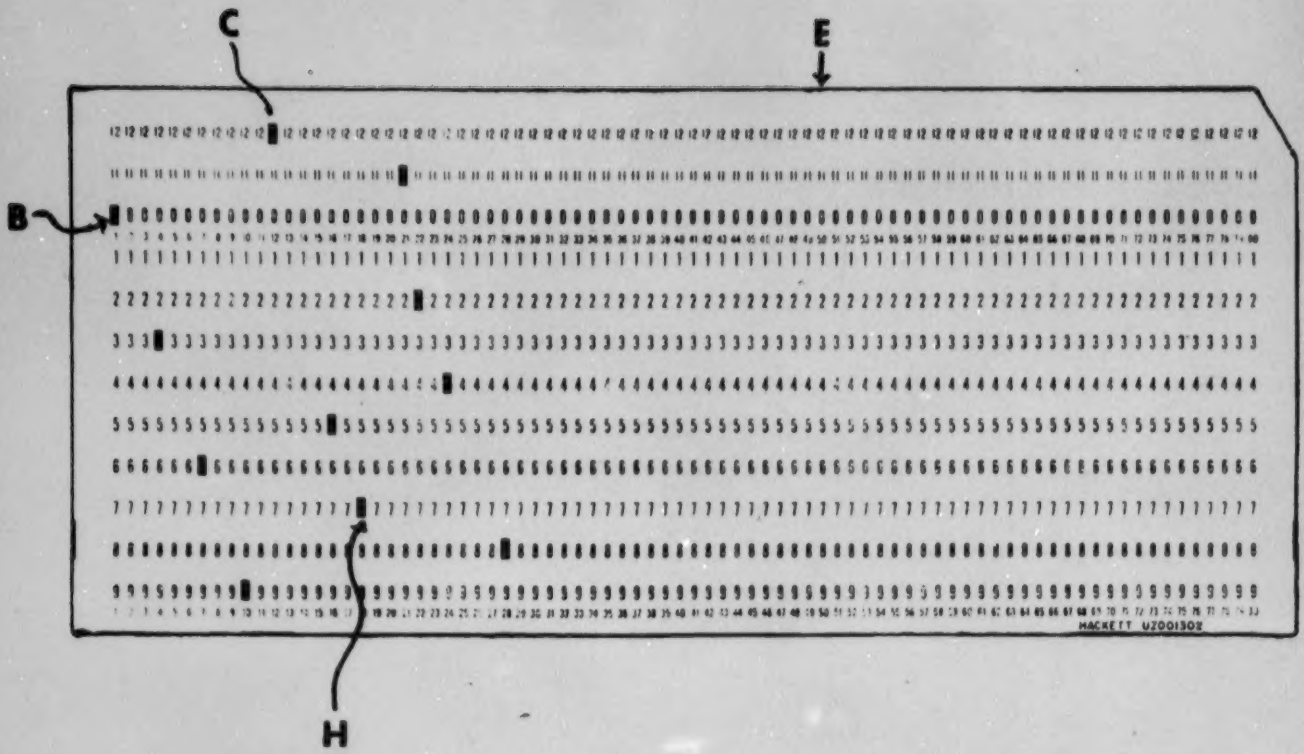
c. Warpage - This is caused by improper stacking and storage of cards. It is also caused by improper climate control in the storage area. So the location of storage is very important when dealing with data processing cards.

d. Laced Cards - Are identified by multiple punching in one or more columns that were not placed there intentionally, that card is said to be laced. Laced cards may occur during duplication on the card punch.

e. Off-Punched Cards - The term off-punched refers to cards in which the holes are not exactly where they belong. The holes may be too high or too low in relation to the correct punching position, or too far to the left or right. If the punch is either too high or too low, the brushes reading the card will sense the hole too soon or too late and the required function may not be performed or performed incorrectly. If the hole is too far to the left or right, then the brush reading that column may not read it all, and perhaps the brush for the adjacent column will. Once again, the machine will not perform as desired.

During the past 2 hours we have discussed the punched card and its characteristics, handling and storage of cards and some of the possible problems that can occur with cards. We also discussed card input and output equipment and error conditions which can appear on this equipment.

The Hollerith code is the oldest and most commonly used coding system used to represent data. Your ability to use this coding system will be a tremendous asset to you in the field and will help you easily grasp other coding systems used in data processing.


C
E
B
H
HACKETT UZ001302

SELF-EVALUATION

1. Item B is:

   a. A zone punch.
   b. A 12 punch.
   c. A 1 punch.
   d. A zero punch.
   e. In row 1.
   f. In column one.
   g. On the one edge.
   h. On the zero edge.

2. The 12 edge is indicated by item:

   a. A.
   b. B.
   c. C.
   d. D.
   e. E.
   f. F.
   g. G.
   h. H.
   i. I.
   j. J.

3. Item C is:

   a. On column 12.
   b. A zero punch.
   c. On 11 punch.
   d. On row 12.
   e. On the 12 edge.
   f. A zero punch.
   g. On column 11.
   h. A 12 punch.
   i. On row 11.

4. Item H is:

   a. A zero punch.
   b. On column 18.
   c. In column 7.
   d. In row 18.
   e. A 7 punch.
   f. In row 11.
   g. In column 11.
   h. The 7 edge.

5. The hollerith code of a 12 punch and a 4 punch represents the character:

   a. D.
   b. G.
   c. K.
   d. O.
   e. 0
   f. W.
   g. /.
   h. &.
   i. 4.
   j. 6

6. The hollerith code of a 12 punch only represents the character:

   a. D.
   b. G.
   c. K.
   d. O.
   e. 0.
   f. W.
   g. /.
   h. &.
   i. 4.
   j. 6.

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7. Select the proper procedures that will offset damage, to computer cards caused by humidity or temperature changes:

a. Fan the cards prior to usage.
b. Condition the card stack to the operating environment.
c. Joggle the cards prior to usage.
d. Stack the cards out in the sun to dry off prior to usage.
e. Store the cards in the computer room at least three days prior to usage.
f. Clean the cards prior to usage.

8. Select from the list below, the examples of computer card damages that are caused by humidity or temperature changes:

a. Card shrinkage.
b. Laced cards.
c. Warped cards.
d. Card rusting.
e. Stacked cards.
f. Conditioned cards.

9. Select the proper procedure that will eliminate card sticking due to static electricity:

a. Clean the cards.
b. Remove the rubber bands.
c. Fan the cards.
d. Spray the cards with static remover.
e. Fan the cards to reduce the stiffness of the cards.
f. Stack the cards in an upright position.
g. Stack the cards in a horizontal position.

10. Identify the two types of card readers:

a. Character-recognition.
b. Optical reader.
c. Photo-electric.
d. Validity reader.
e. Brush reader.
f. Interpreter reader.

11. The example of a validity check condition is a:

    a. The card is warped due to humidity or temperature changes.

    b. The card column has a punch hole combination of 12, 2, 5 punches.
    c. The card has holes that are off punched.
    d. The card column has a punch hole combination of 12, 3, 8 punches.
    e. The card's edge is frayed and cannot be read by the card reader.
    f. The first set of read brushes, hole count did not agree with the second set of read brushes count.

12. The examples of a read check condition are:

    a. The card is warped due to humidity or temperature changes.
    b. The card column has a punch hole combination of 12, 2, 5 punches.
    c. The card has holes that are off punched.
    d. The card column has a punch hole combination of 12, 4, 8 punches.
    e. The card's 9 edge is frayed and cannot be ready by the card reader.
    f. The first set of read brushes hole count did not agree with the second set of read brushes count.

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ANSWER KEY

1. d., f.
2. e.
3. a., d., h.
4. e.
5. a.
6. h.
7. b., e.
8. a., c.
9. c.
10. c., e.
11. b.
12. c., f.

01-03-29

US ARMY INSTITUTE OF ADMINISTRATION
Fort Benjamin Harrison, Indiana 46216

INPUT AND OUTPUT PRINTERS

Prepared for: Computer/Machine Operator Course

Prepared by: Hardware Division, Data Processing Department

October 1978

STUDENT NAME: _____

CLASS NO. _____

FOR INSTRUCTIONAL PURPOSES ONLY

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INTRODUCTION

During your career as a computer operator, you will be responsible for operating the printers in the computer room. In this lesson you will be given a preview of printers you may encounter. You will be introduced to the most common printers being used in data processing installations. The printer is a very important device. It translates the results of processing in a legible permanent copy (hardcopy) which can easily be understood by those unfamiliar with ADP.

A huge amount of work is accomplished before we receive the printout from the printer. Most often the user never sees the work being performed but only the results. It will be your responsibility as a computer operator to insure the user receives the best possible output. It is important for that reason to become aware of computer printers and their operation.

BODY

1. Types of Printers: The computer printer can be one of two types. These types are:

   a. Impact Printer

   b. Nonimpact Printer

2. Impact Printers: An impact printer is when the printing mechanism of a printer makes physical contact (impact) with the computer form during the printing process. A good example of an impact printer is a standard office typewriter. The pressure of your finger on a key causes the character you selected to strike an inked ribbon which is pressed against the form. The impact of the character causes it to appear. The printing mechanism of an impact printer can be like a typewriter.

3. Computer printer speeds are measured as:

   a. character-at-a-time

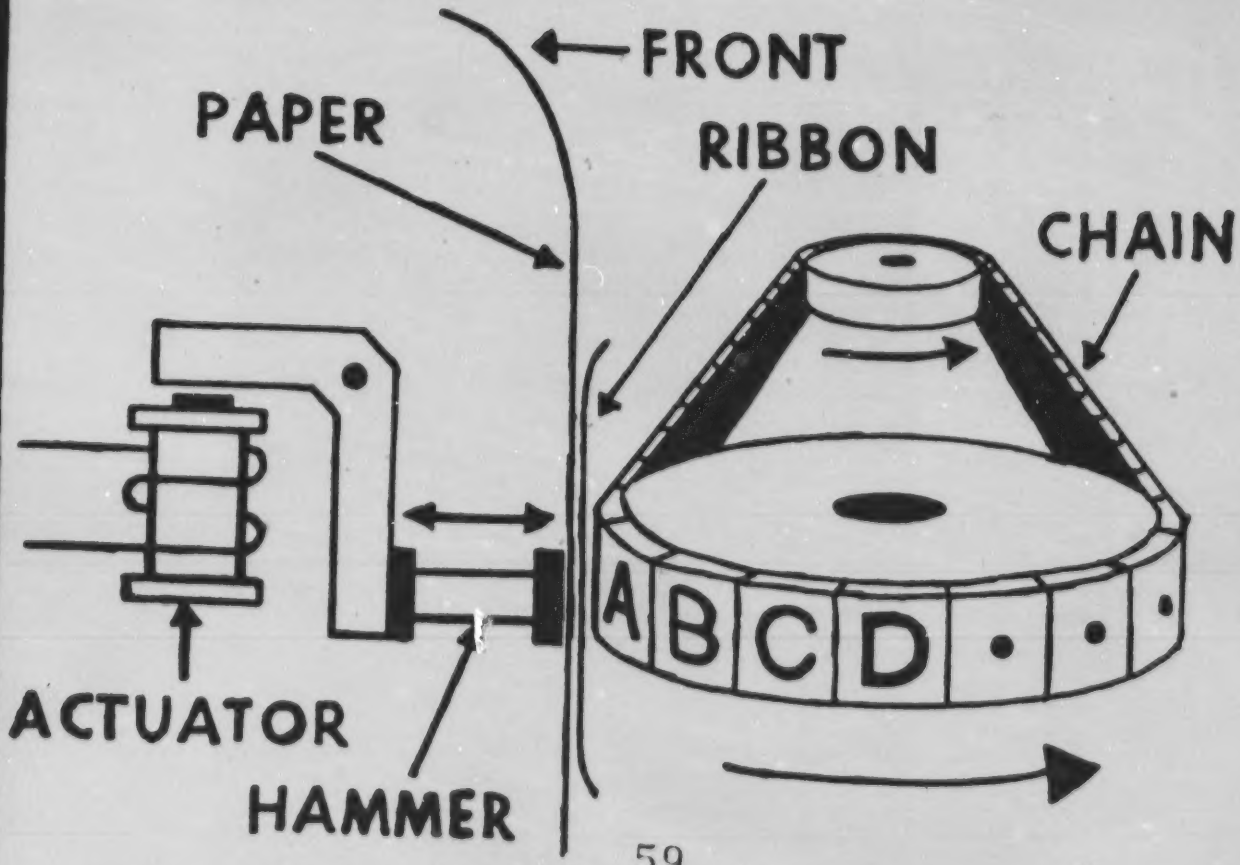
   b. line-at-a-time

   c. page-at-a-time

4. Impact printers use different print mechanisms and are categorized by the print mechanism it uses. There are several categories of impact printers and these printers print a character-at-a-time or a line-at-a-time.

Illustration #1

CHAIN



a. Chain Printer: A chain printer's mechanism consists of a series of sections, normally five sections arranged side by side. In a five-part chain, a complete set of alphabetic, numeric, and special characters are included on each section. The chain is mounted horizontally and revolves from left to right at a constant speed. As the chain rotates, hammers located behind the computer form are timed to select the desired character. The inked ribbon between the character and the hammers leave an imprint of the selected character. The chain printer prints at a speed of a line-at-a-time. Maximum speed for a chain printer is 2500 lines per minute.

See Illustration #1

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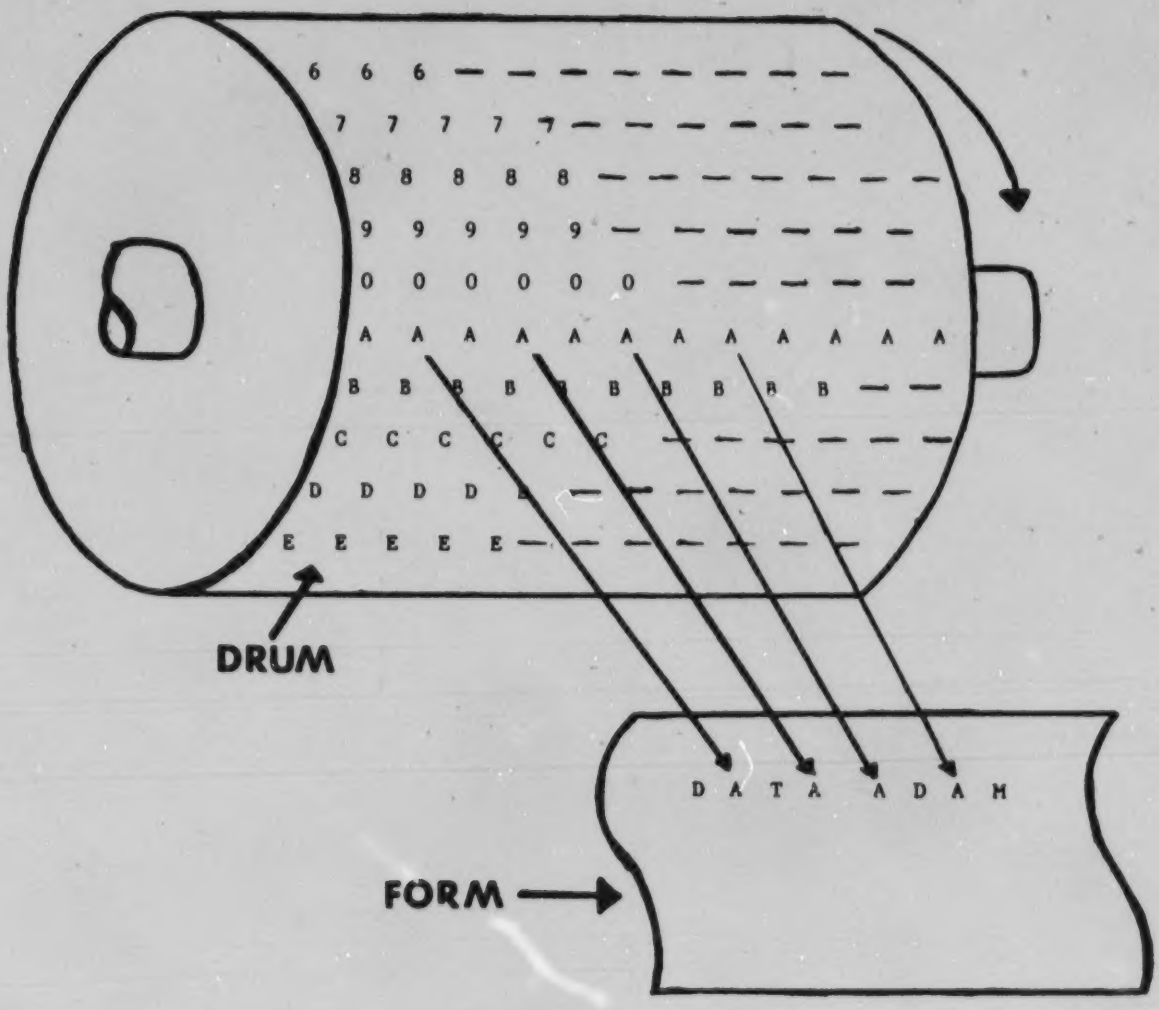

DRUM PRINTER

Illustration #2

b. Drum Printer: A drum printer employs a solid cylindrical drum with raised characters around it. Only one character appears across one row of the drum. As the A-row passes the line to be printed, hammers behind the computer form strike the form against the drum, causing one or more A's to be printed. As the B-row moves into place, any print position requiring the letter B is printed in the same manner. One complete revolution of the drum is required to print each line. The drum printer is a line-at-a-time printer.

See Illustration #2

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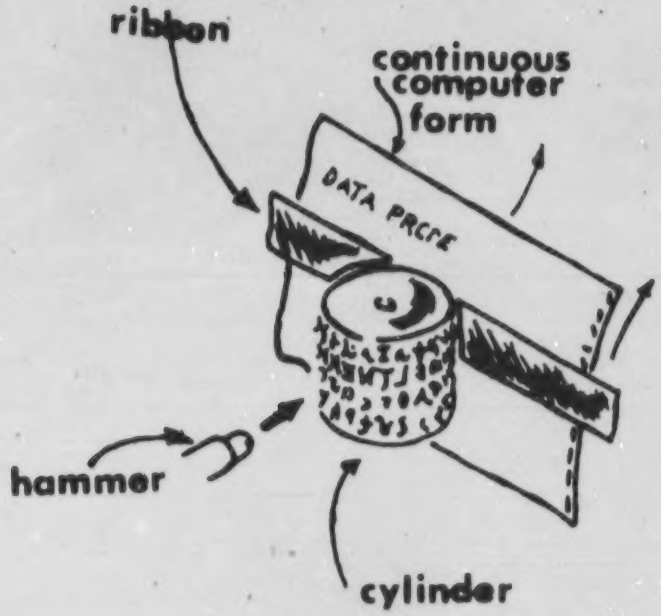

CYLINDER PRINTER

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Illustration #3

c. Cylinder Printer: The printer mechanism is normally used in inquiry devices. An inquiry device is a device used for communication with the computer system. It is both an input and output device. The computer prints information to the computer operator on the inquiry device and the operator can key in information to the computer system. The printer consists of a cylinder with one set of characters on the surface of the cylinder. The cylinder is mounted in a vertical position and is rotated and moved up and down on its axis to position the character for printing. After the character is positioned, a hammer strikes the cylinder pressing the printer ribbon and computer form together to create the character image. This printer prints at a speed of a character-at-a-time. This printer prints a maximum of 10 characters per second. The cylinder printer is extremely noisy during operation and has poor print quality.

See Illustration #3

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GOLF BALL PRINTER

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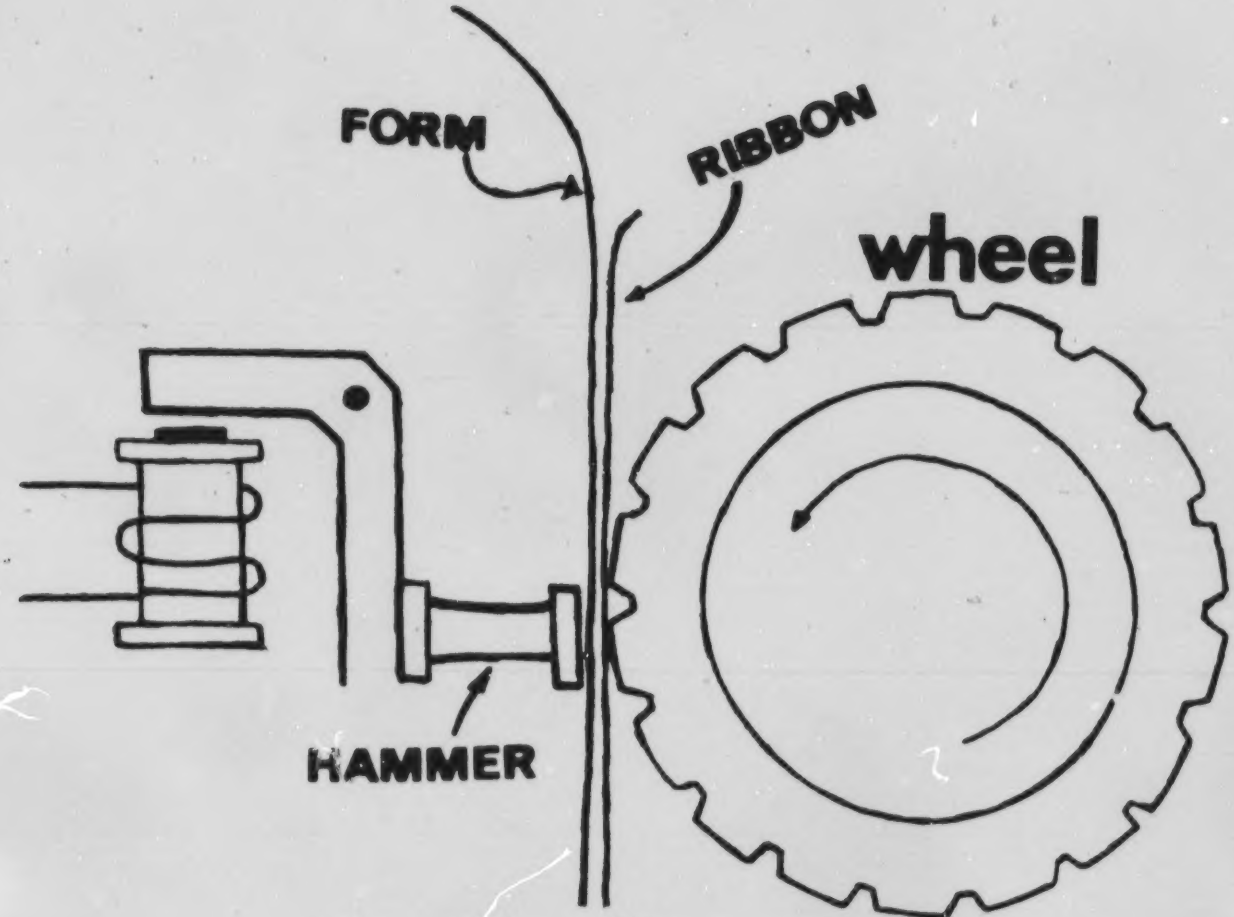
Illustration #4

d. Golf Ball Printer: This printer mechanism is a modern version of the Cylinder Printer, its main difference from the Cylinder Printer is the lack of a hammer mechanism. The print head, similar in shape to a golf ball, stikes the printer ribbon and computer form in the same manner as the cylinder printer. The ball is rotated and is moved up and down to position the print character. This printer has a removable print head and different balls of various print styles may be interchanged. This print mechanism is also used in inquiry devices.

See Illustration #4

WHEEL

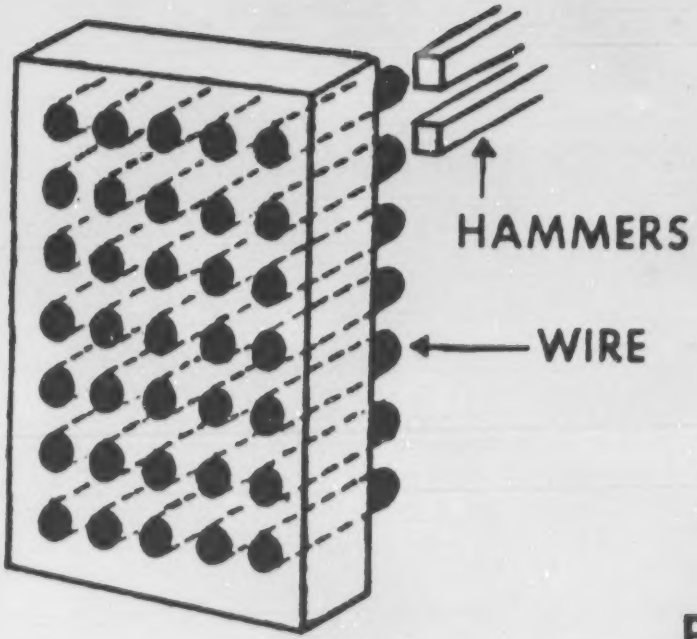
Illustration #5



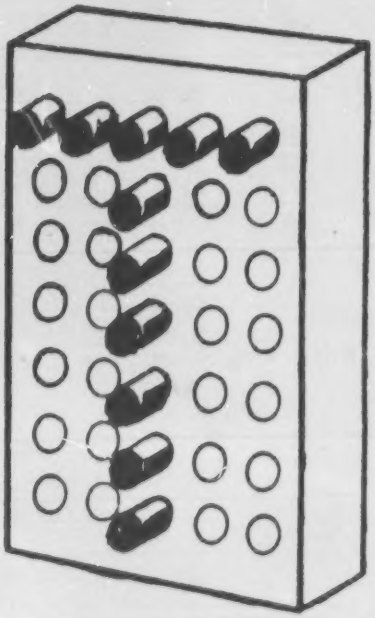
e. Wheel Printer: This printer employs one set of characters with each character raised on the surface of the wheel. The wheel is mounted in a vertical position and is rotated to position the selected character. When the character is positioned, a hammer presses the ribbon and form against the wheel to print the character. This printer is similar to the drum printer. The difference between the two is the necessity for a wheel for each print position. This printer prints at a speed of a character-at-a-time with a maximum of 120 characters per second.

See Illustration #5

f. Band or Belt Printer: This printer mechanism operates in the same manner as the chain printer. The only difference from the chain printer is the use of a continuous band of steel or reinforced polyurethane with the characters on the band or belt instead of a chain consisting of several sections. This category includes models which print a character-at-a-time and models which print a line-at-a-time, and is used as in inquiry device and computer output printer.



CHARACTER BLOCK



BLOCK ACTIVATED WITH A CHARACTER "T"

MATRIX PRINTER

Illustration #6

g. Matrix Printer: This printer mechanism is used in conjunction with inquiry devices and keypunch machines. A matrix printer consists of pins arranged in a block (matrix). Behind the block of wires is a set of hammers corresponding to the number of wires contained in the block. The hammers strike the appropriate wires in the block to cause an impression of the character to be made on the computer form. This is a relatively fast technique, providing there is a matrix for each print position. This category includes both character-at-a-time and line-at-a-time printers.

See Illustration #6

DAISY WHEEL

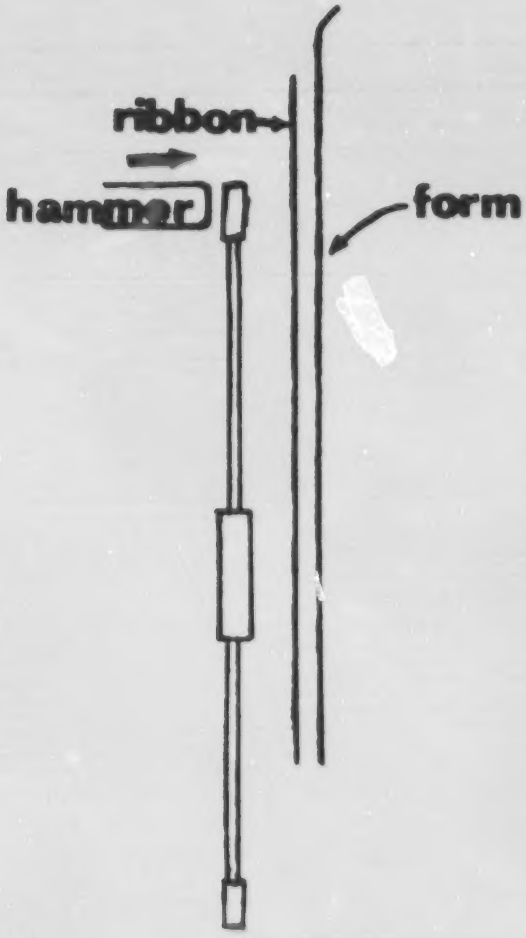


Illustration #7

h. Daisy Wheel: This category is called a daisy wheel because of the configuration of the print mechanism. The print mechanism consists of arms arranged in the form of a daisy which have one character at the end of each arm. This mechanism is mounted in a vertical position for printing. The arm is pressed against the ribbon and form to create the character. This printer prints a character-at-a-time and can be used in inquiry devices.

See Illustration #7

i. Nonimpact Printers: The main difference between the nonimpact printer and the impact printer is the nonimpact's lack of physical contact with the computer form. Most nonimpact printers print by using an intricate electrostatic or photo-chemical process. The ink jet is an exception. The ink jet printer shoots droplets of ink on the computer form to form the character image. Some nonimpact printers can print at extremely high speeds and can print a page-at-a-time. Though nonimpact printers cannot print carbon copies, some models are capable of printing several original copies in the same time some impact printers take to print the same number of copies using multipart forms. One disadvantage of the nonimpact printer is the need for specially coated forms which increases printing costs. The nonimpact printer is available as inquiry device printers and computer output printers.

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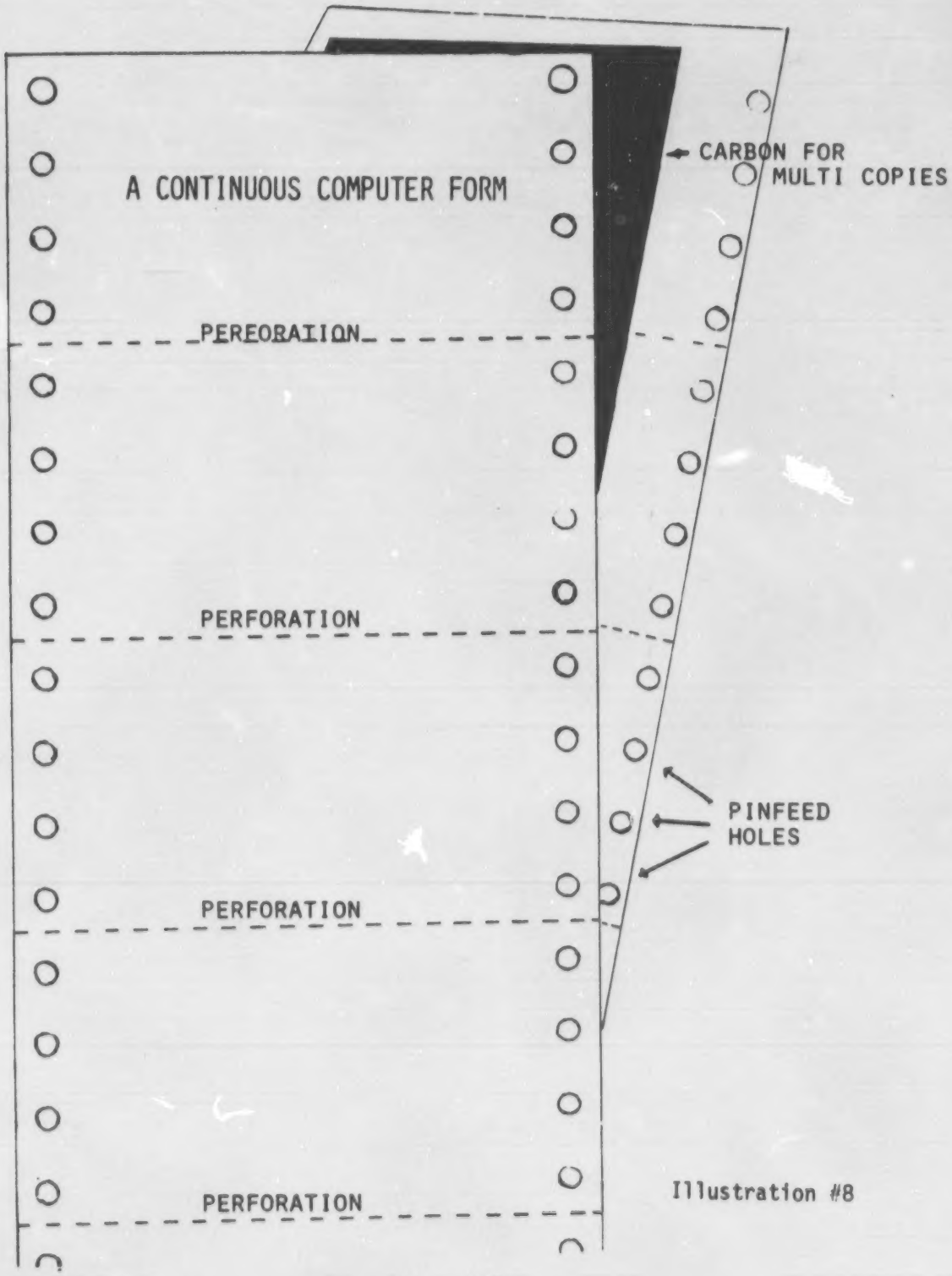

Illustration #8

6. Computer Forms: The computer form is available in single or multipart (more than one copy, usually ranging from one copy to six copies.) See Illustration #8

Multipart forms normally use a carbon between each sheet. However, some multipart forms are carbonless. Carbonless multipart forms use a special chemical coating that disperse on impact to form a character. As stated earlier, nonimpact printer use a single part form which is especially coated with a chemical but the form is different from carbonless multipart forms. Nonimpact printers use forms which respond to electrical or chemical processes rather than from impact. Computer forms are continuous. They appear to be one continuous sheet, but really they are several sheets with a perforation between each sheet so they may be separated into single sheets after printing.

The process of separating forms at their perforation is called bursting. Large quantities of forms are bursted on a device called a burster which is capable of separating computer printout forms at a high speed.

Once multipart forms are printed, the carbons are removed from between each copy. This is called decollation. The device used for the decollation process is called a decollator. This process is completed before the bursting process.

A standard size computer form is 14 x 13 inches and is commonly referred to as 1413 forms. Special size forms are created for special applications and may vary in width and length. The margins of the computer form have prepunched holes called pinfeed holes which are used to feed the form through the computer printer during the printing process.

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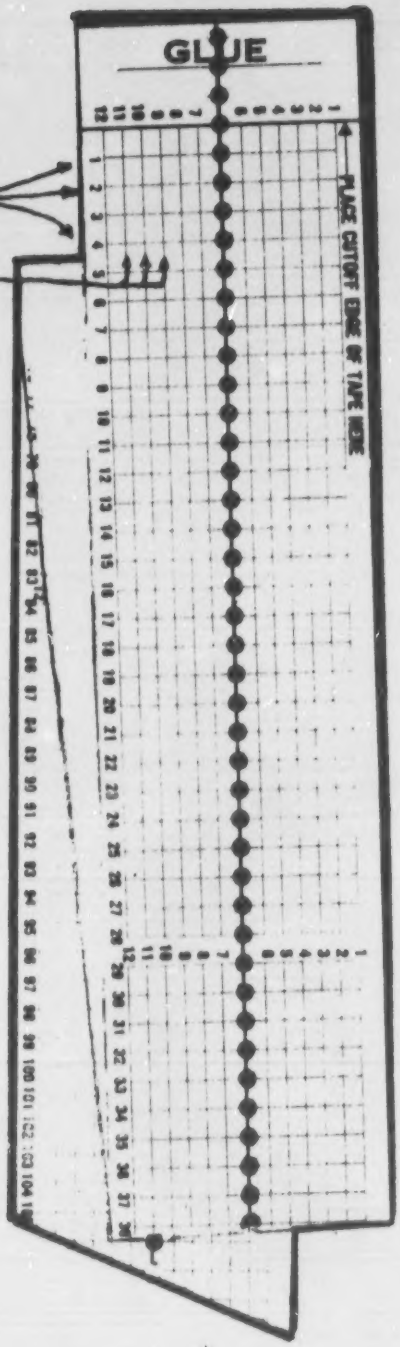
7. Carriage Control: When the printer completes the printing of a line on a form, the form must then be advanced to allow another line to be printed. This function and others are performed by the carriage. The carriage automatically feeds a new form into place, ejects the printed form and skips and spaces the form during printing. Since forms can be various lengths and users may desire various formats, the carriage control unit uses a carriage control tape to meet these needs. The carriage control tape is made of a heavy grade paper which is inexpensive and easily prepared. The carriage control tape could be considered a program for printing forms. We can prepare a carriage control tape for each program that has printed output.

This example of a carriage control tape can control the movement of continuous forms that have sheet lengths up to 22 inches. This tape is available in lengths of 132 print lines that correspond to the print lines on the printer;

the vertical lines are called channels (there are 12 channels). By punching a hole on the carriage control tape where a print line meets a channel line, an operator can cause the form to be pre-positioned on the corresponding print line of the computer form. These holes are usually identified as channel punches and are numbered 1 through 12 depending on what channel line the hole is punched.



Normally a punch on channel 1 indicates the first line of print that will be printed on the form. A punch in channel 12 usually indicates the last line of print that will be printed on the form. Channel lines 2 through 12 are normally used to position the form anywhere between the first and last line of print. Once the channel punches are punched in the tape, the carriage control tape is then cut and glued to form a loop. The carriage control tape is then mounted on the carriage control unit where it will continuously revolve around the carriage control unit while it is controlling the movement of every form that is being printed.

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When punching a carriage control tape, a method to use is to:

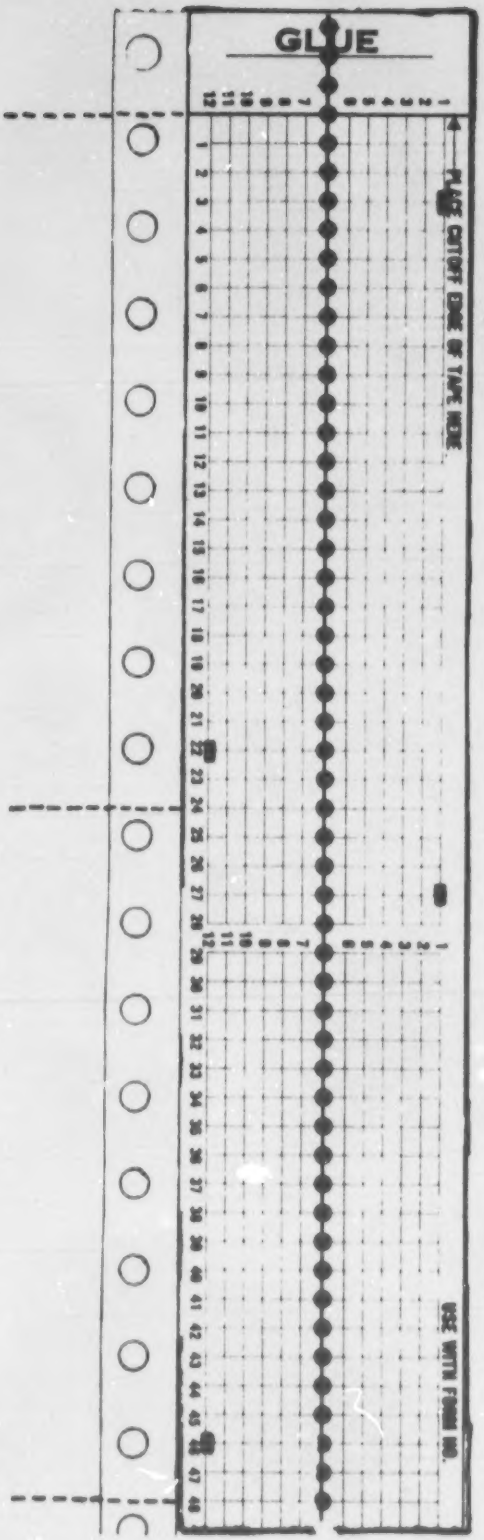
a. Line the carriage control tape so line "Ø", is even with the top perforation of the form to be printed.

b. The first line of print in this example is the third line of the form. Therefore, a channel 1 punch has been punched in line 3 of the carriage control tape.

c. The last line to be printed on the form in this example is line 22 of the form. A channel 12 punch has been punched on line 22 of the carriage control tape. The 12 punch will cause the carriage control unit to begin searching for a channel 1 punch. As the carriage control tape rotates and stops at the channel 1 punch the completed form will be ejected and a new form will be positioned at print line 3 and printing will resume.

d. If other punching positions are required to create a particular format, channel punches 2 through 11 may be required to be punched into the carriage control tape. These instructions should be received from the programmer since the programmer designs the format and incorporates carriage control during the creation of the program.

In the example shown, the form is only 24 print lines long. When a form is only a few inches in length, the channel punches should be repeated several times along the length of the carriage control tape. With only one set of channel punches in the carriage control tape, the tape may be too small to properly fit the carriage control unit once the tape is cut and the ends are glued together to form a loop.



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8. Form Storage Requirements: In accordance to Army Regulation 18-7, Data Processing Activity Management, Procedures and Standards, there are storage requirements for ADP supplies which includes computer forms that you should adhere to:

a. Computer forms will be stored in an area that will provide adequate environmental and fire protection. At a minimum, computer forms must be stored in a controlled environment like the computer room for the purpose of conditioning it to the environment in which they are to be used.

b. Shipping cartons will be stacked in a manner that will not damage the contents. Normally, the cartons will be stacked no more than three cartons high. Cartons of computer printout forms should be stored on pallets to raise them above the floor to eliminate the possibility of drawing dampness from the floor.

c. Computer printout forms will be kept neatly arranged to provide ready access to the materials. High standards of cleanliness in these areas will be adhered to in order to reduce risk of fire and to insure that the computer room is not contaminated.

9. Operator Responsibility: The computer operator has the following responsibilities in regard to the computer printer.

a. The operator is responsible for mounting the correct type of form according to the job instructions.

b. The operator must insure that the form is properly aligned for vertical and horizontal alignment. (That is, the form must be adjusted to cause printing to begin at the first line of print.) (These considerations are similar to that of a standard office typewriter.)

1. The print position or vertical alignment is similar to setting the margins of a typewriter.

2. The horizontal adjustment is similar to positioning the paper in a typewriter.

c. The operator is responsible for mounting the correct carriage control tape as stated in the job instructions and adjusting the carriage control tape as stated in the job instructions and adjusting the carriage control tape to the correct print position.

d. The operator performs preventive maintenance limited to cleaning the inside and outside surfaces of the printer. The operator must take precautions when cleaning the interior areas of the printer and avoid areas where electrical mechanisms and wiring are present to prevent electrical shock to himself and possible damage to the printer.

e. The operator is responsible for changing the printer ribbon when it is worn out.

f. The operator is responsible for the disposition of forms once printed to include labeling per run instructions, marking security classifications, and proper handling of classified forms.

10. Common Error Conditions: The following errors are most common during printer operation.

a. Form Stop or Check: This error occurs when a form is not properly fed and positioned in the computer printer. The printer will normally halt so corrective action can be taken by the computer operator.

b. Synchronous error: This is an error due to the carriage control and printer mechanism being out of timing.

c. Run-away Forms: This error is most often caused by a damaged carriage control tape or a malfunction in the carriage control mechanism. When this error occurs, the computer forms feed through the printer at a high rate of speed with no printing occurring. In a short period of time a large quantity of forms will be fed through the printer. Until the carriage control unit is halted, the printer will continue to feed blank forms through the printer at a high rate of speed.

d. Print Check: Some printers will detect when it fails to print all the requested characters on the line it printed. This error is normally caused by a hardware malfunction. Normally, the printer will try to print the line again.

11. We have discussed the computer printer, computer forms, form storage requirements, carriage control and operator responsibilities.

In later lessons you will be given the opportunity to operate a computer printer and inquiry device. If you do well on the self-evaluation for this lesson, you are ready to continue. Should you have trouble with the self-evaluation, take time to review your handout. It is important you know this material so you will better understand your later lessons on the computer printer.

Self-Evaluation

1. True or False. An impact printer is a printer that makes physical contact with the form during the printing process. _____

2. Computer printer speeds are measured as

   a. character-at-a-time

   b. print positions-at-a-time

   c. line-at-a-time

   d. page-at-a-time

   e. cartons per hour

3. Select from the list below, those printers which are impact printers.

   a. matrix

   b. chain

   c. ink jet

   d. zerographic

   e. drum

4. True or False. Impact printers make physical contact with the computer form during the printing process. _____

5. True or False. Nonimpact printers are capable of printing multipart forms. _____

6. True or False. Most nonimpact printers print by using an intricate electrostatic or photo chemical process. _____

7. True or False. An inquiry device is an input and output device. _____

8. True or False. Inquiry devices are used as a means of communication with the computer system. _____

9. True or False. Pinfeed holes are used to tell the printer when to eject a form. _____

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Self Evaluation (Continued)

10. Select the functions performed by the carriage.

    a. eject the printed form
    b. spaces the form during printing
    c. prints the form
    d. separates the form at the perforation
    e. feed new forms into place after a form is printed

11. True or False. The carriage control tape can be considered a program for printing forms. _____

12. True or False. The channel 1 punch indicates the last line of print. _____

13. True or False. There are normally 12 channels in a carriage control tape. _____

14. True or False. Channels 2 through 11 are used to position the form between the first and last line of print. _____

15. True or False. Computer forms are continuous. _____

16. True or False. The operator is responsible for all preventive maintenance for the computer printer. _____

17. Cartons of computer forms normally should not be stacked more than:

    a. 10 high
    b. 3 high
    c. 6 high
    d. 5 high

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Self Evaluation (Continued)

18. The operator is responsible for

    a. changing the printer ribbon

    b. cleaning of the interior and exterior surfaces of the printer.

    c. changing the print mechanism

    d. labeling printed forms per run instructions

19. True or False. A synchronous error is an error due to the carriage control and printer mechanism being out of time. _____

20. True or False. A Form Check or stop occurs when a form is not properly positioned or fed in the printer. _____

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ANSWER KEY

1. True
2. a, c.,d
3. a., b., e.
4. True
5. False
6. True
7. True
8. True
9. False
10. a., b., e.
11. True
12. False
13. True
14. True
15. True
16. False
17. b.
18. a., b., d.
19. True
20. True

01-04-29

US ARMY INSTITUTE OF ADMINISTRATION
Fort Benjamin Harrison, Indiana 46216

MAGNETIC TAPE INPUT AND OUTPUT

Prepared for: Computer/Machine Operator Course

Prepared by: Hardware Division, Data Processing Department

October 1978

STUDENT NAME: _____

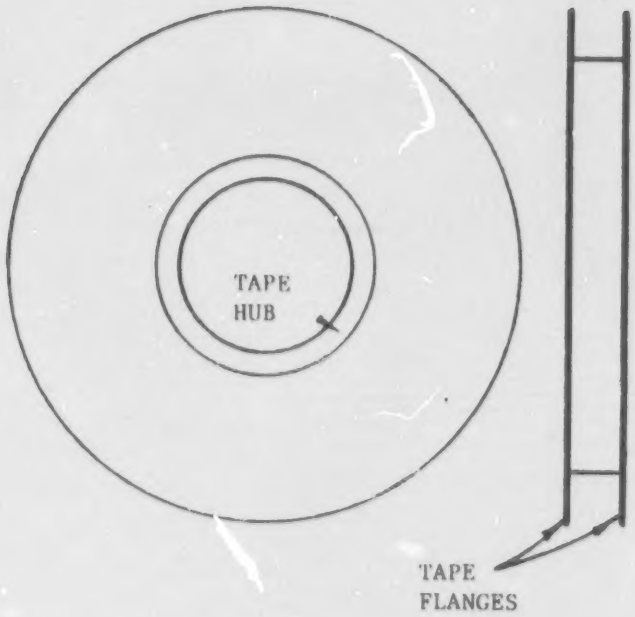
CLASS NO. _____

FOR INSTRUCTIONAL PURPOSES ONLY

INTRODUCTION

Magnetic tape was a tremendous addition to data processing. Unlike the punch card which is a permanent record, the magnetic tape can be used over and over again. If you consider costs, magnetic tape is both effective and inexpensive. We can store huge amounts of data in a fraction of the space required to store the same amount of data on punch card and at the fraction of the cost.

In the field you will use a large amount of magnetic tape for processing. The material in this lesson is designed to provide you with the knowledge required to handle most situations you will encounter in your installation.


TAPE
HUB
TAPE
FLANGES

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1. Physical Characteristics: Computer magnetic tape is very similar to the tape used in many home tape recorders. However, even though there are similarities, recording music is nowhere near the same as recording computer data. A slight error in a musical note might not be detected by human ears but a slight error in computer data that is recorded would surely be detected by an individual when he receives his paycheck. This is why the recording of data must be very accurate. A tiny speck of dust which would not interfere with the recording of music could prevent accurate recording of data. Small imperfections that result in lost data on magnetic tape can cause an entire computer job to be rerun on the computer. This is a waste of valuable computer machine time. Magnetic computer tape must be of the highest quality, free of any imperfections and thoroughly tested for errors before it is used on the computer. The manufacturing of magnetic tape is really very simple. Long strips of clear flexible plastic serves as a base. This plastic is very thin, about as thin as a cigarette paper. These plastic strips are coated on one side with small particles of iron oxide mixed with a binding agent. After the magnetic layer hardens, the strips are cut into 1/2 inch ribbons, wound on reels and tested for errors. The tape width does not have to be 1/2 inch. There are different widths for different applications, but 1/2 surely is the most common. The length of the tape can also differ. A full reel of tape generally contains 2400 feet of tape but lengths as short as 50 feet can be used. A full reel of 2400 feet of tape weighs about 4 pounds can contain data equivalent to that of 480,000 punch cards punched in all 80 columns. The cost to the Army today is about $15.00. The reel that the tape comes on is made of durable plastic and varies in size to accomodate the different lengths of tape. The 2400 foot reel is most common, it is approximately 10.5 inches in diameter.

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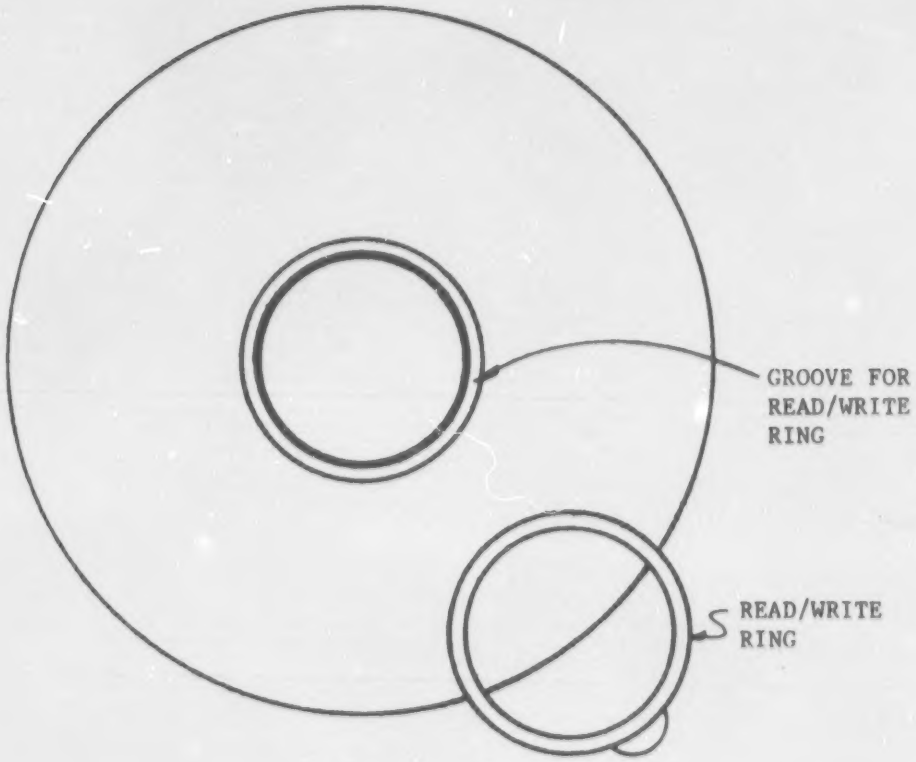

Illustration #1

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In the back of the reel is a round groove. This groove is for a plastic ring. The ring must be placed in the back of the reel to enable the tape drive which reads and writes the data, to write on the tape. This ring is called a read/write ring. Because the writing operation destroys any previous data on the tape, it is necessary to remove the ring if the data is to be saved. If the ring is removed, no recording can take place and the data is protected against any accidental writing which could erase valuable data. A good statement to remember as a self-promoter when using the ring is "no-ring - no write". A tape that contains no data or data that may be written over and destroyed is called a scratch tape. Once valuable data is recorded on a scratch tape it is called a output tape and saved for later use. After the data is no longer needed, the tape becomes a scratch tape again and the cycle is continued.

See Illustration #1

There are many different ways to store data, you've already seen that information can be stored in the form of a punch card as a secondary storage media, so why do we need magnetic tape? You already know one reason - size. Which would you rather carry around, 480,000 punch cards or one reel of magnetic tape? Another reason is speed. The card reader reads at a maximum rate of 1,000 cards per minute. The device which reads data from tape can operate approximately 100 times faster. Therefore, the central processing unit can get information much faster from magnetic tape.

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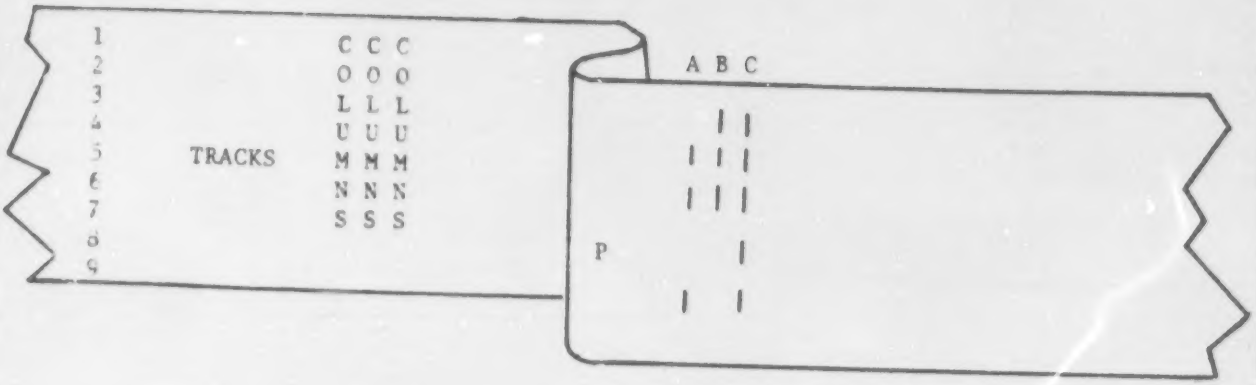

Illustration #2

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2. Data Reading: Information is written on magnetic tape by magnetizing areas or spots in parallel rows. The magnetized spots, called "BITs" are positioned across the width of the tape. Thus data becomes a series of "BIT columns" along the length of the tape. Each of these columns (BIT columns) can represent an alphabetic, special character or numeric DIGIT.

See Illustration #2

Just as we have rows in a punch card we also have rows on magnetic tape. However, these are not called rows, instead they are called TRACKS. The number of tracks a tape drive has depends on the type of tape drive recording the information. Tape drives are designed as seven or nine track drives. Nine track drives are most common. An example of a nine track bit configuration is shown on the illustration.

The word "density" refers to the amount of information which can be stored on a given length of tape (amount of BIT COLUMNS per-inch). There are different densities for different tapes and tape drives, with the most common being 800 and 1600 BITS-PER-INCH (BPI). This means we can put 800 or 1600 BIT columns or characters on 1 inch of tape. This tells us that the information in a punched card (80 columns) fully punched can fit on 1/20 inch of magnetic tape, if written at a density of 1600 BPI.

Records on a tape can contain any amount of characters. Unlike the punched card which can contain only 80 characters. One record is separated from another by a blank space approximately 6/10 of an inch long. This is called the inter-record gap (IRG). Sometimes two or more records are grouped together, this is called a Block of Records. Block of Records are separated by a gap like the inter-record gap called a inter-block gap (IBG). Blocking saves tape space and speeds data input since the tape drive will not have to stop and start as often during the reading and writing process.

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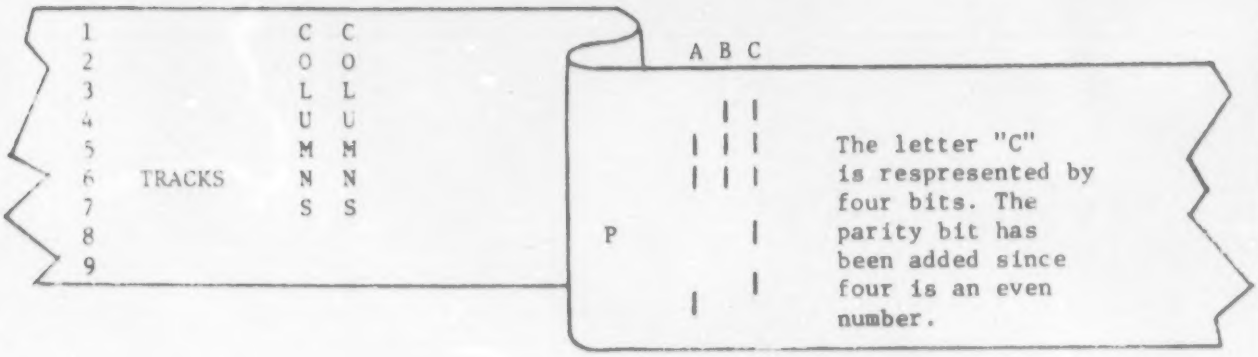

"P" indicates parity bit location

Illustration #3

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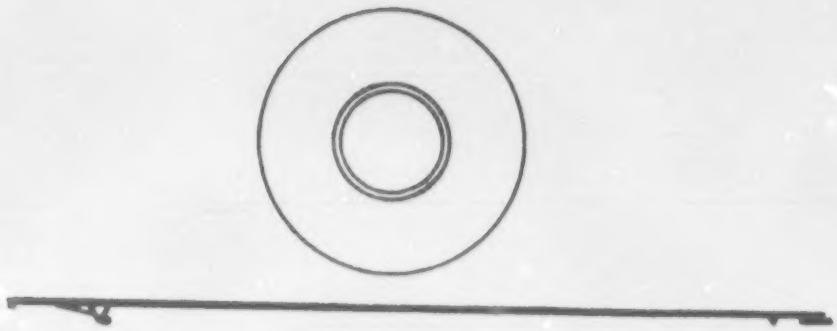
3. Parity Checking: The computer system uses a checking process called parity checking to insure data is written or read correctly. Parity checking insures valuable data is not lost due to tape damage or machine malfunction.

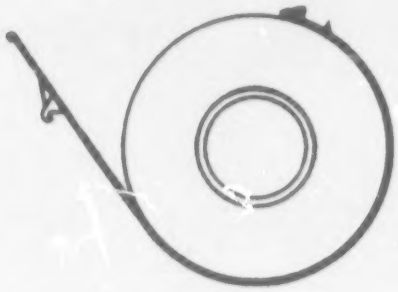
In each column used to represent a character or digit, a space for a parity bit is available in the column. In the example shown you can see this space indicated by the letter "P".

A system designed for odd parity checking will count the bits required to represent the character or digit. If the total is an even number, the system will add the parity bit in the parity bit location so the total will be an odd number. Each column will have a odd number of bits. When the columns are read, the system will sense an error if a column has an even number of bits. The example shows odd parity checking.

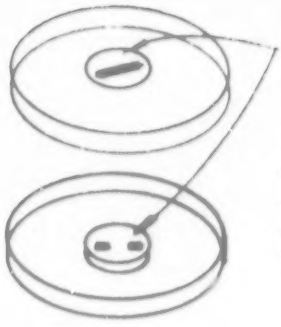
See Illustration #3

A system designed for even parity checking will insure each column has an even number of bits by adding the parity bit when a column has a odd number of bits needed to represent the character or digit. If a column has an odd number of bits when read, the system will sense a data error.





THE WRAPAROUND BAND IS A THICK PLASTIC BAND WITH A SIMPLE PLASTIC LOCKING DEVICE



This is a cannister consisting of two sections used to store and protect magnetic tape.

Illustration #4

4. Storage: A reel of tape must be protected at all times. The wraparound band protects the tape on the reel and the reel itself. The wraparound band prevents contaminates from contacting the tape surface and also prevents the reel from warpage. The wraparound band is a thick plastic strip that is wrapped around the tape and connected by a simple plastic locking device.

See Illustration #4

Some installations store and protect tape by storing them in a plastic container called a canister. The canister consists of two sections that is locked together by turning a handle located on the top section of the canister.

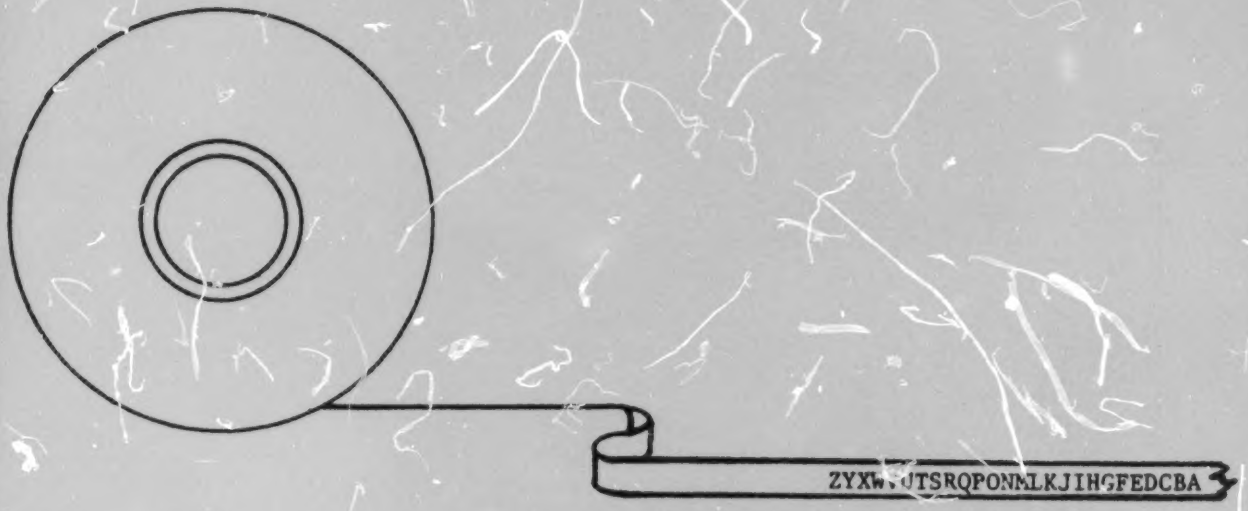
5. Data Recording Review: We have discussed how information is recorded on magnetic tape. You have learned:

a. Small magnetic spots called bits are used to represent characters or digits on the surface of magnetic tape.

b. Density refers to the amount of information that can be stored on a given length of tape.

c. Records can be grouped together in a Block of Records. Blocking records reduces the amount of space needed to store records and saves time when the records are read.

d. Parity checking insures valuable data is correctly read or written.



Magnetic tape files are sequential files

Illustration #5

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6. Sequential File: In a previous lesson you learned that a group of related records is called a file. A magnetic tape file is a sequential file. A field in a record is normally used to sequence a file. For example, a personnel file would probably be in alphabetical sequence. The last name would be used as the field for sequencing. All names beginning in the letter "A" would be recorded at the beginning of the tape and all names beginning with "Z" would be recorded last. The tape drive is unable to immediately go to the names beginning in "Z" without reading those names beginning in A, B, C, etc.

See Illustration #5

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VOLUME 1 OF 3

VOLUME 2 OF 3

VOLUME 3 OF 3

Illustration #6

7. Multi-volume File: A file that is too large to be recorded on only one reel of magnetic tape is continued on additional reels of tape. Each tape is called a volume like a novel that consists of volumes, too large to be placed in only one hardback cover. The volumes are numbered sequentially as recorded. The volumes are numbered 1, 2, 3. . . A file that is recorded on more than one volume is called a multi-volume file. For example, if we recorded the names of all the soldiers in the U.S. Army, it would probably require more than one reel of tape (Volume). Let's assume we can record the names on three reels of tape. In our example the first reel contains the names of individuals whose names begin in A thru H. The second reel contains the names of individuals whose names begin in I thru M and the third reel contains the names of individuals whose names begin in N thru Z. You remember we discussed that a tape file is a sequential file. In the illustration of our imaginary file you will notice we recorded it in alphabetical sequence. The volumes are numbered on the external and internal label in the sequence recorded. Our first volume is volume 1, the second is volume 2 and the third is volume 3. Also, we included on the label the total number of volumes required. In the example our first volume is volume 1 of 3, the second is 2 of 3 and the third is 3 of 3. This helps insure we mount all the tape and in the proper sequence when read in.

See Illustration #6

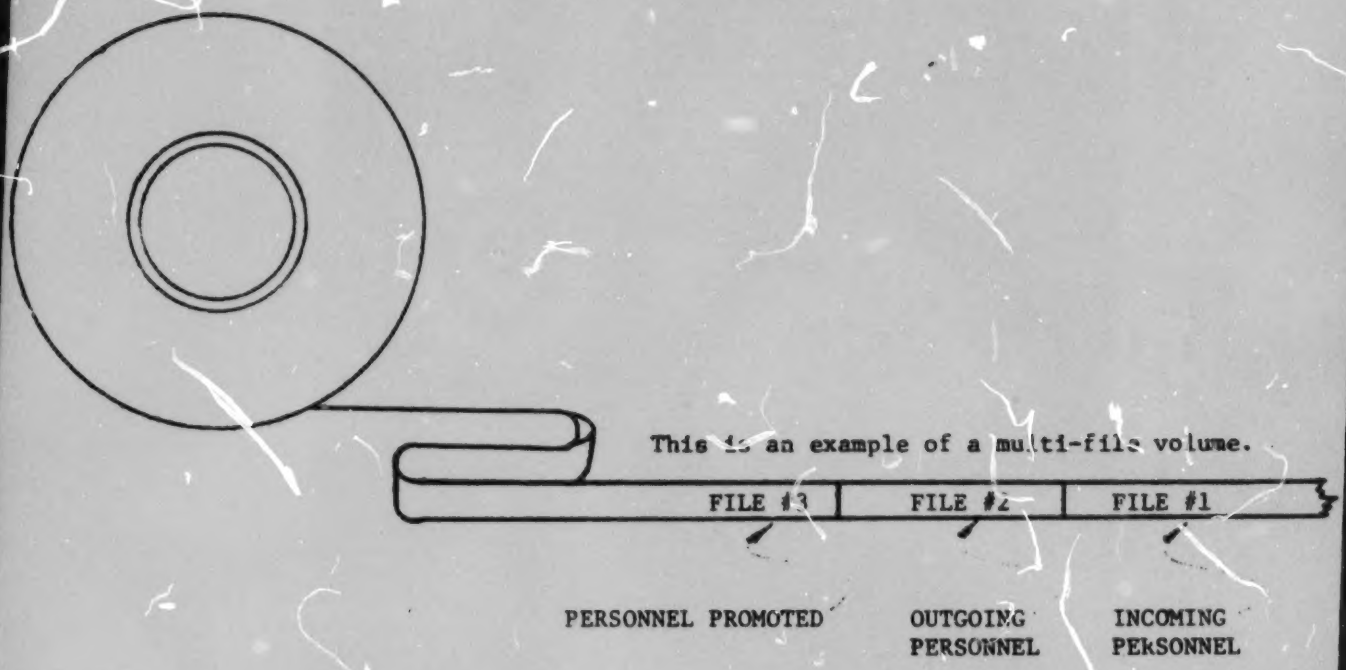


Illustration #7

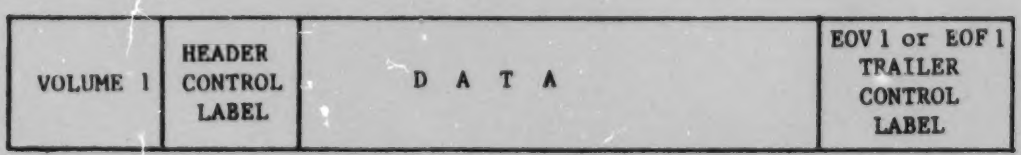
8. Multi-File Volume: In data processing two main concerns are space and speed. Sometimes, a data processing installation will record related files on one volume or volumes for these reasons. The volume or volumes is called a multi-file volume. There is a distinct difference between a multi-file volume and a multi-volume file.

See Illustration #7

The multi-file volume is two or more related files recorded in a series on one or more volumes of tape. The multi-volume file is only one file recorded on more than one volume of tape.

Remember the main difference is the number of files not volumes. Our example shows a multi-file volume consisting of three personnel files. Our first file is incoming personnel, the second is outgoing personnel and the third file is a file of personnel recently promoted.

AN UNLABELED TAPE



STANDARD LABELED TAPE

Illustration #8

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9. Data Formatting: We have discussed how information is recorded on magnetic tape. Now let's discuss how the data is formatted on the tape.

See Illustration #8

Data can be any records making up a file. You have learned that related groups of records are called a file.

All files on magnetic tape are separated by a series of electrical impulses called tape marks. The tape mark is used by the tape drive in its operation.

There are certain internal labels that can be written on magnetic tape. These labels identify the contents of the tape. If these labels are not used we will have only our data preceded and followed by a tape mark. This is called an unlabeled tape.

If labels are used we will have three labels:

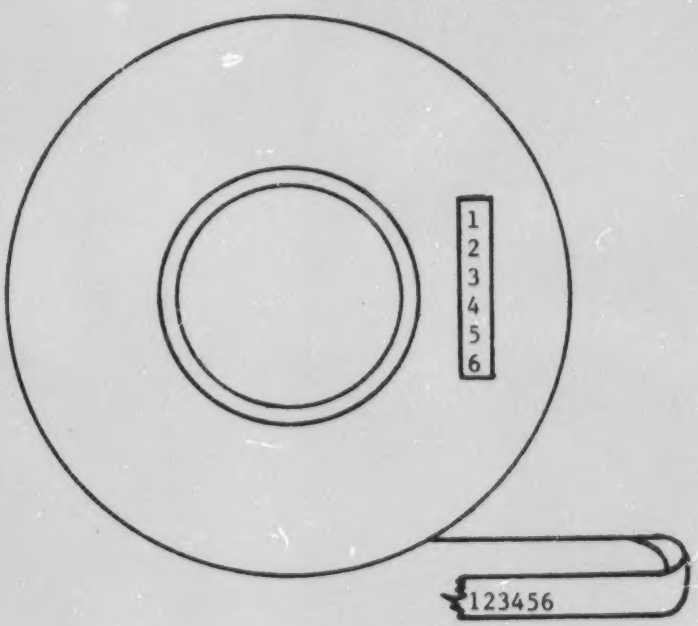
a. Volume 1 label (VOL 1)

b. Header label (HDR 1) before our tape mark and data

c. Trailer Control label at the end of the data (EOV1 or EOF1). These labels we are discussing are called standard labels. A tape which includes these labels is called a standard labeled tape.

VOL1	volume serial number	NOT USED	NOT USED	NOT USED
1 4	5 11			80

Volume Serial Number on front of tape on external label



Volume Serial Number on wraparound band on external label

Illustration #9

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1. Volume 1 Label (VOL1): The volume 1 is a 80 position recorded written on the surface of the tape. This is the first record on the tape. The first four positions of the record are used for the label identifier "VOL1". Positions 5 thru 10 are used for the volume serial number. The volume serial number is written on the surface of the tape by the computer when it is first received at the installation. The volume serial number is also written on external labels on the tape reel. This number is unique to the installation. The installation will number their reels in sequence and store them on shelves in sequence to provide a system for easy retrieval from their tape library, similar to a library for books. This number is a permanent identification of the reel, as long as it is used for files, with standard labels. Should the internal label be written over accidentally, the installation will write the number on the tape again. This information can be obtained from the external label. Positions 11 thru 80 of this record are not normally used.

See Illustration #9

EOF1 or
EOV1

HDR1	FILE IDENTIFIER or DATA SET NAME	FILE SERIAL NUMBER	VOLUME SEQUEN NUMBER	FILE SEQUEN NUMBER	NOT USED	NOT USED	CREAT -ICN	EXPIRA -TION	NOT USED
1 4	5 21	22 27	28 31	32 35	36-39	40-41	42-47	48-53	54 80

POSITIONS

1-4 Identifier "HDR1"

5-21 File Identifier (File ID) or Data Set Name (a data set name is the name written to output magnetic media. It is the same as the file ID).

22 22-27 Contains the volume serial number from the first or only volume.

28-31 Volume sequence number used for multi-volume files to insure that tape reels are mounted in the sequence created when read-in. Single volume files will have ØØØ1 in these positions.

32-35 File sequence number used for multi-file volume sequence. A multi-file volume is a volume with more than one file recorded on its surface.

36-39 Not normally used

40-41 Not normally used

42-47 Creation Date. The system writes the date the file or files were created.

48-53 Expiration Date. The date the file is no longer needed and may be written on again.

54-80 Not used

01-04-29

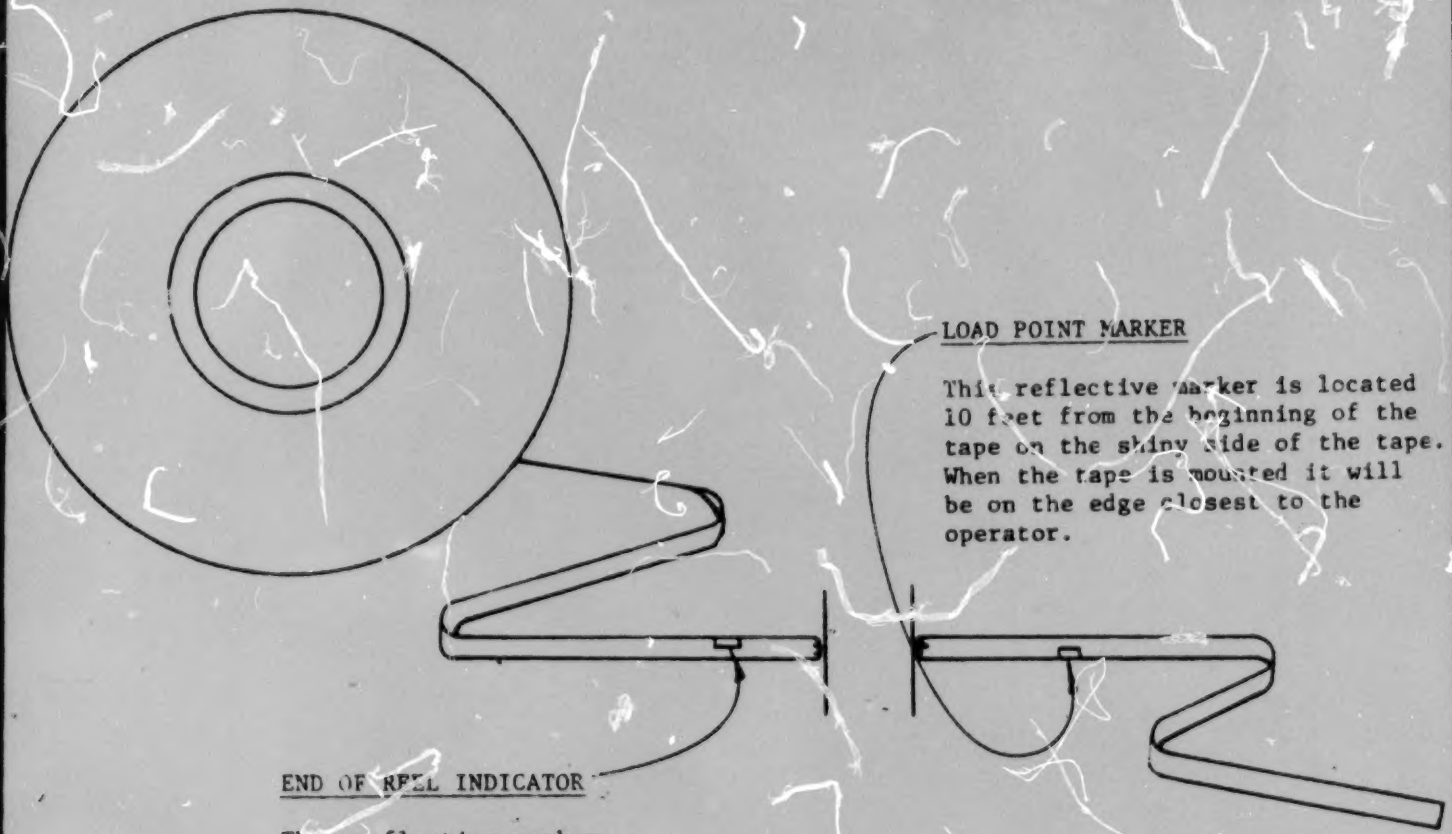
Illustration #10

2. Header Label (HDR1): Each tape has a header label used to identify the file recorded on the tape. There is more than one header label on a multi-file volume since it has more than one file recorded on the tape. This is also a 80 position record. See Illustration #10

3. Trailer Control Label (EOV1 or EOF1): The trailer control label is the same as the Header 1 with two exceptions:

a Positions 1 thru 4 will have either EOF1 for end of file or EOV1 for end of volume. Earlier in this lesson we discussed how a file can be too large to be recorded on one volume. Each tape (volume) that contains only part of the file would have EOV1 in positions 1 thru 4. The tape with the last records of the file would have EOF1.

b Positions 55 thru 60 contains the total number of blocks of records written on the volume. The system will count the number of blocks of records when the file is read and checks it against the number in these positions. If the totals do not agree, the system will sense a block of records or more have not been read and a error has occurred.



LOAD POINT MARKER

This reflective marker is located 10 feet from the beginning of the tape on the shiny side of the tape. When the tape is mounted it will be on the edge closest to the operator.

END OF REEL INDICATOR

This reflective marker is located 14 feet from end of tape. It is located on the shiny side of the tape on the edge furthest from the operator when the tape is mounted.

100

10. Tape Markers: The tape drive is a precision device that must be told where usable tape begins and ends on the tape reel. The magnetic tape has two markers for this purpose:

See Illustration #11

The first marker is called a load point marker. It is a silver reflector 1 inch by 3/16 inch located 10 feet from the beginning of the tape. When the tape is mounted on the tape drive this reflector will be facing towards the operator. This marker must not be more than 1/32" from the edge of the tape. The tape drive interpets this as the beginning of usable tape and will begin reading and writing depending on the operation at this point. The ten feet leader before the load point marker is used for threading the tape on the tape drive. This ten feet is the only portion of the tape that the operator will touch with his hands thus preventing contaminates such as fingerprints and dirt from contacting the surfaces where data is written.

The second marker is the end of reel indicator located 14 feet from the end of the tape. This marker is located furtherest on the edge from the operator when the tape is mounted on the tape drive. This marker must not be more than 1/32" from the edge of the tape. By locating the marker on opposite sides of the tape, the tape drive will know whether it is at the beginning or end of the tape. The fourteen feet located at the end of the tape has one additional purpose besides protection from contaminates. The four additional feet will be available for the tape drive to write a trailer label after it senses the end of reel indicator.

11. Care and Handling of Magnetic Tape: The recording and reading of magnetic tape are done at very close tolerances and the tape drive also operates on close tolerances, so close, that a particle of dust can cause errors. It is one of the operator's responsibilities to insure that the tape drive is cleaned at proper intervals. Remember the following rules when handling magnetic tape:

a. Do not pinch tape reel flanges. This could damage the tape and, in turn, lose or cause data to be misread.

b. Keep the tape storage area free of all dust, including paper-form dust. This will reduce the possibility of contaminating tape. Because of the close tolerance discussed, a speck of dust can cause read or recording errors and cause the tape to be scratched or damage the read write head.

c. All labels must be of a nonshedding material. Otherwise, dust and dirt may be generated causing errors or damage as discussed in b. above.

d. If tape reel canisters are used, keep reel canister cover closed, even when the tape reel has been removed. The canister in which the tape is stored should be the cleanest area in the computer room. The canister should not be opened outside the clean room environment.

e. Do not use clear cellophane tape to affix anything to the reels or tape. The gummy adhesive can work loose and stick to the tape surface. Again, damage and errors will result.

f. Destroy damaged reels, do not use them as take-up reels. A broken or badly distorted reel can quickly damage a tape edge, making the tape useless, and the debris generated from nicked tape can be held in the machine and contaminate other areas.

g. Never touch the tape beyond the load marker; information is recorded from this point on. Fingerprints are nothing more than deposits of oil and salt which are excellent holding areas for dust and lint which contaminates the reel of tape.

h. Handle tape reels by the hubs. The hub is the strongest part of the reel and will not pinch your tape.

i. Clean tape flanges frequently when reel bands or tape seals are used in place of reel cases.

j. Clean dust covers periodically to assure the canister is the cleanest item in the computer room. Use a lint cloth dampened with an approved cleaner.

k. Do not use a reel of tape that has been dropped. Damage could have occurred to the tape and the tape should be carefully inspected prior to use.

l. Maintain recommended temperature and humidity control for tape. The smaller the environmental change experienced by the tape, the better the operation and reliability. Tape will expand and/or contract with significant temperature change. This expansion/contraction effects the relative position of bits of data prerecorded on tape. Reading and writing under such variation of temperature will cause data errors.

m. Keep tops of tape drives free of all articles. Accidents do happen and residue or debris can cause damage to the tape unit or to the tape.

n. Never use an eraser on a gum label that is attached to the tape reel. Again, erasure particles can adhere to the tape surface causing read and write errors.

o. Periodically, snip damaged ends of tape on 'scratch' reels and relocate load point marker if necessary.

p. Keep tape reels from coming in contact with clothing, as particles of dust and lint can be picked up.

q. Maintain accurate tape usage logs. Accurate logs will enable usage analysis in order to schedule tape inspection and cleaning. Your installation will have a tape cleaning machine for this purpose.

r. Do not store tape reels near transformers or other electronic type equipment. Any magnetic omissions can rearrange data on the tape. In addition, excess heat can cause unwanted expansion in the tape. In many ways, careful tape handling is common sense. Attention to good handling procedures will significantly reduce the possi bility of tape damage or lost data because of operator carelessness.

In the second half of this lesson we have discussed the format of data on the magnetic tape. You have learned:

a. A magnetic tape is a sequential file.

b. A file that is too large to be recorded on one reel of tape is continued on additional reels. Each tape reel is a volume and is numbered in the sequence recorded. This is called a multi-volume file.

c. A multi-file volume is a volume or volumes with two or more files recorded on its surface.

d. A unlabeled tape is a tape that does not include standard labels.

e. A tape that included standard labels is called a standard labeled tape.

f. If standard labels are used, the tape will have these three labels:

(1) Volume 1 Label (VOL1)

(2) Header Control Label (HDR1)

(3) Trailer Control Label (EOV1 or EOF1)

g. The load point marker is a silver reflector sensed by the tape drive. This marker indicates the beginning of usable tape on the tape reel. It is located on the shiny side of the tape ten

feet from the beginning of the tape on the side facing towards the operator when the tape is mounted on the tape drive. Remember this marker must not be placed more than 1/32 of an inch from the edge of the tape.

h. The end of reel indicator is the same as the load point marker except it indicates the end of usable tape and is located 14 feet from the end of the tape on the shiny side of the tape. When viewed it will be on the side furthest from the operator when the tape is mounted on the tape drive. This marker must also be no more than 1/32 of an inch from the edge of the tape.

You are probably wondering why it is necessary to know all this when you can't read magnetic tape with your eyes anyway? When operating you will come across situations when your knowledge of magnetic tape and the terms involved will easily help you correct the situation and get the job going again.

SELF EVALUATION

1. True or False — Magnetic tape may be written over again and again. _____

2. True of False — Data can be stored in a fraction of the space required to store punch cards when stored on magnetic tape. _____

3. True or False — Recording on magnetic tape must be extremely accurate. Any error can cause a problem. _____

4. True or False — The read/write ring is not used when recording data. _____

5. True or False — A scratch tape is a tape which contains no data or data that is no longer needed and may be recorded over. _____

6. True or False — Magnetic tape is used for the reasons of space and speed. _____

7. True or False — The wraparound band is used to protect punch cards. _____

8. True or False — A bit is a magnetic spot used to represent data on magnetic tape. _____

9. True or False — Just like the punch cards, we have rows on magnetic tape. _____

10. True or False — Density refers to the amount of information that can be stored on a given length of tape. _____

11. True of False — Groups of records on magnetic tape are called blocks of records. _____

12. True or False — BPI stands for blocks per inch. _____

13. True or False — Blocking records save space. _____

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14. The parity bit is used to:

    a. check to insure blocks of records are not lost during the reading of a file on tape.

    b. insure a column on magnetic tape is not in error.

    c. save time.

    d. increase speed during the reading and writing operation.

15. A tape file is:

    a. a alpha numeric file.

    b. a sequential file.

    c. a non-sequential file.

    d. a random access file.

16. True or False — A multi-volume file is a file consisting of more than one file. _____

17. True or False — Tape reels containing files have interval and external labels. _____

18. True or False — An unlabeled tape is a tape which does not use standard labels. _____

19. True or False — A tape mark is a series of electrical impulses separating files. _____

20. True or False — The tape mark is used by the tape drive in its operation. _____

21. True or False — If standard labels are used on magnetic tape, there will be six labels. _____

22. True or False — The Volume 1 label is the permanent identification of the tape when standard labels are used. _____

23. True or False — The header 1 label is used to identify the contents of the tape. _____

24. True or False — The trailer control label is the same as the header 1 label with two exceptions. _____

25. True or False — The load printer marker and end of reel indicator tell the tape drive where usable tape begins and ends on the tape reel. _____

ANSWER KEY

1. True
2. True
3. True
4. False
5. True
6. True
7. False
8. True
9. False
10. True
11. True
12. False
13. True
14. b.
15. b.
16. False
17. True
18. True
19. True
20. True
21. False
22. True
23. True
24. True
25. True

01-05-29

US ARMY INSTITUTE OF ADMINISTRATION
Fort Benjamin Harrison, Indiana 46216

MAGNETIC DISK INPUT AND OUTPUT

Prepared for: Computer/Machine Operator Course

Prepared by: Hardware Division, Data Processing Department

October 1978

STUDENT NAME: _____

CLASS NO. _____

FOR INSTRUCTIONAL PURPOSES ONLY

INTRODUCTION

In the block of instruction on magnetic tape input/output you learned that:

a. It is a high speed input/output media

b. It can hold many data records

c. It can be recorded on many times

d. It requires very little storage area

One disadvantage that magnetic tape has, is that if you want to read the last record on a tape file, you must read all the data records on the file. This actually requires valuable computer time.

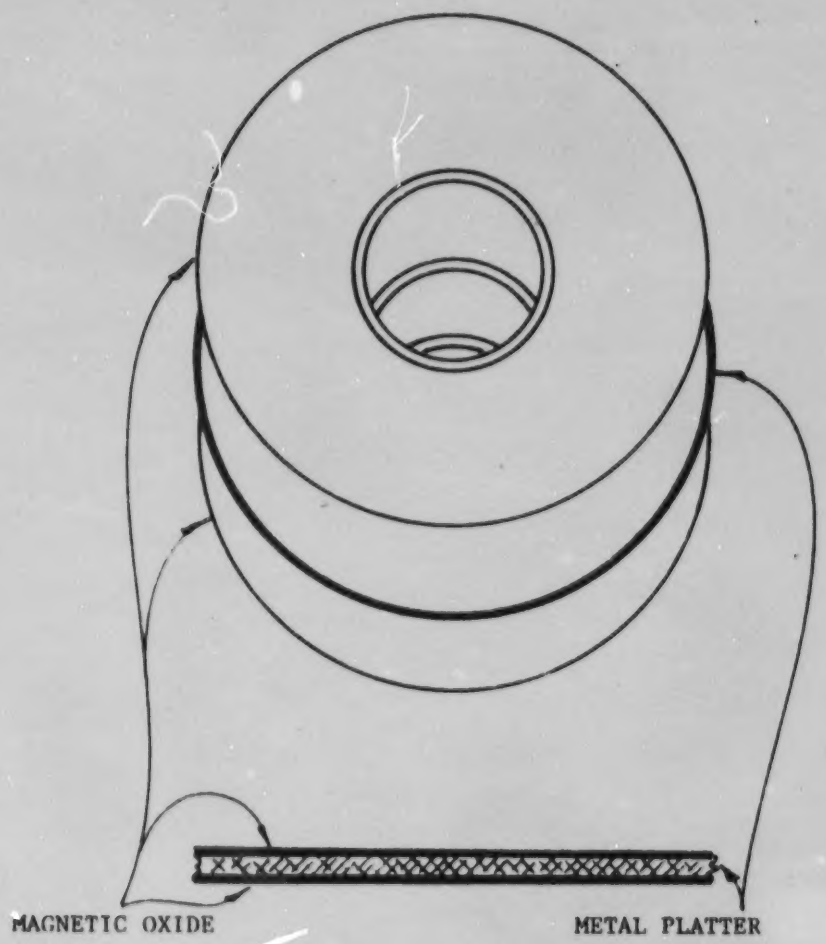

Illustration #1

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Magnetic disk saves computer time by combining the qualities of magnetic tape with the advantage of being able to pass over data records when they do not need to be read.

Before we discuss how magnetic disk is able to pass over data records, let's first mention some of the physical characteristics of a magnetic disk pack.

1. Physical Characteristics of the Magnetic Disk:

a. A magnetic disk is a metal platter which is coated with magnetic oxide similar to that oxide which is on magnetic tapes. This is where the magnetic bits that represent data are recorded, or read by the read/write heads. See Illustration #1

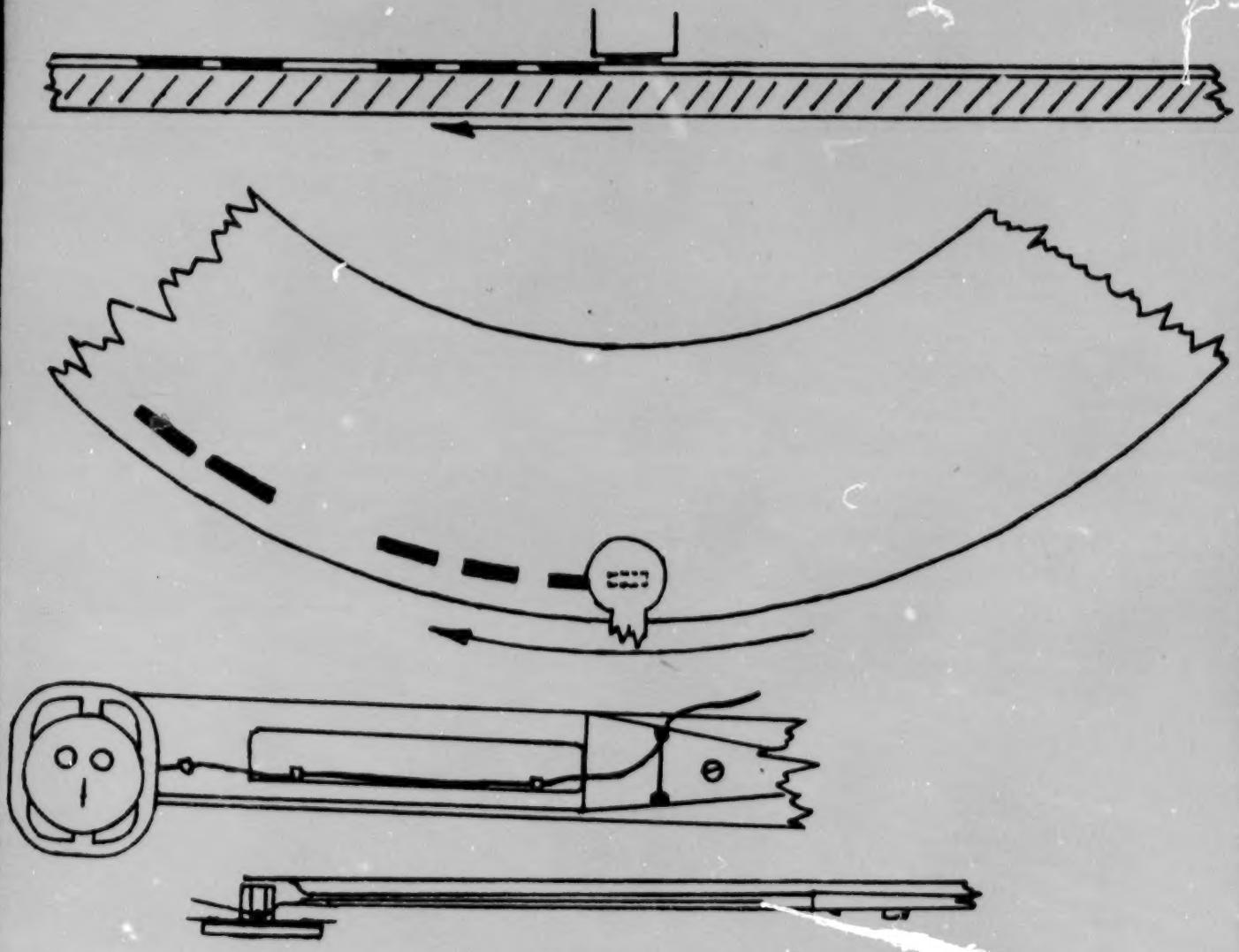

Illustration #2

b. When magnetic disk is being used, it is placed on a device called a disk drive, and rotated at a high rate of speed.

When information is recorded on the surface of a platter at this high rotating speed, it creates a circular pattern. This circle of data that is recorded is called a track.

See Illustration #2

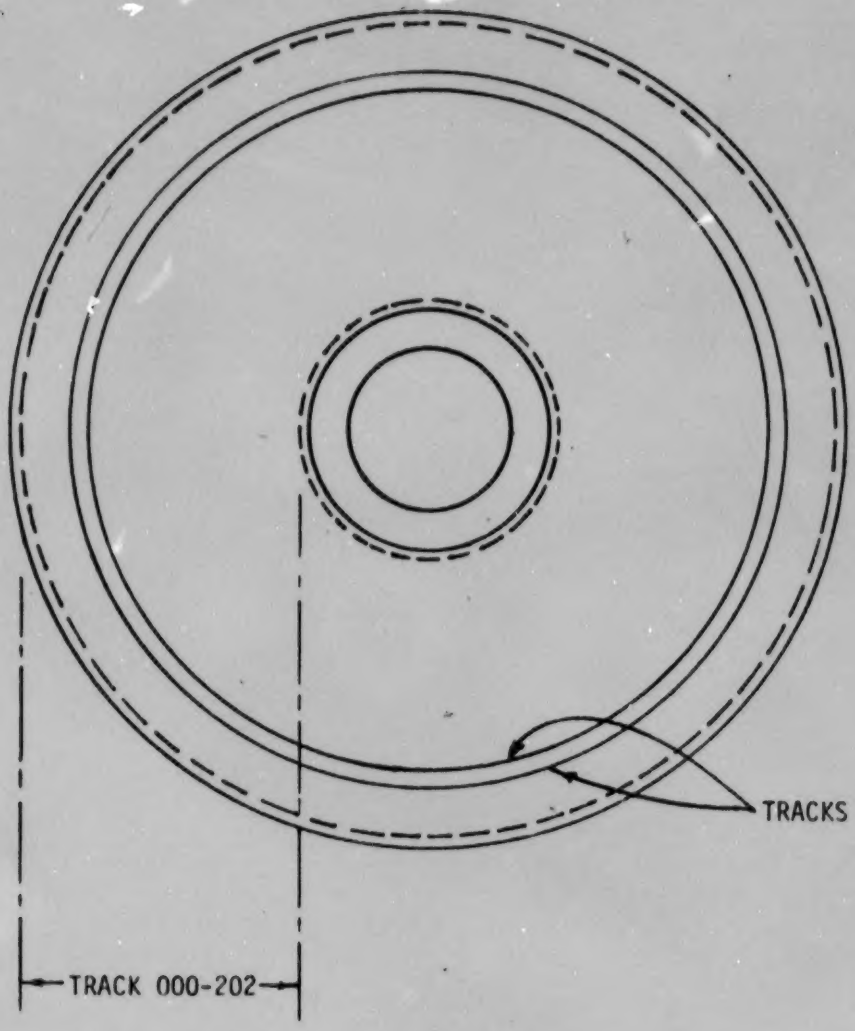

Illustration #3

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c. On the example we are using, there are two hundred three (203) positions that the read/write head can be placed, as a result a single recording surface on a disk platter can have two hundred three tracks. See Illustration #3

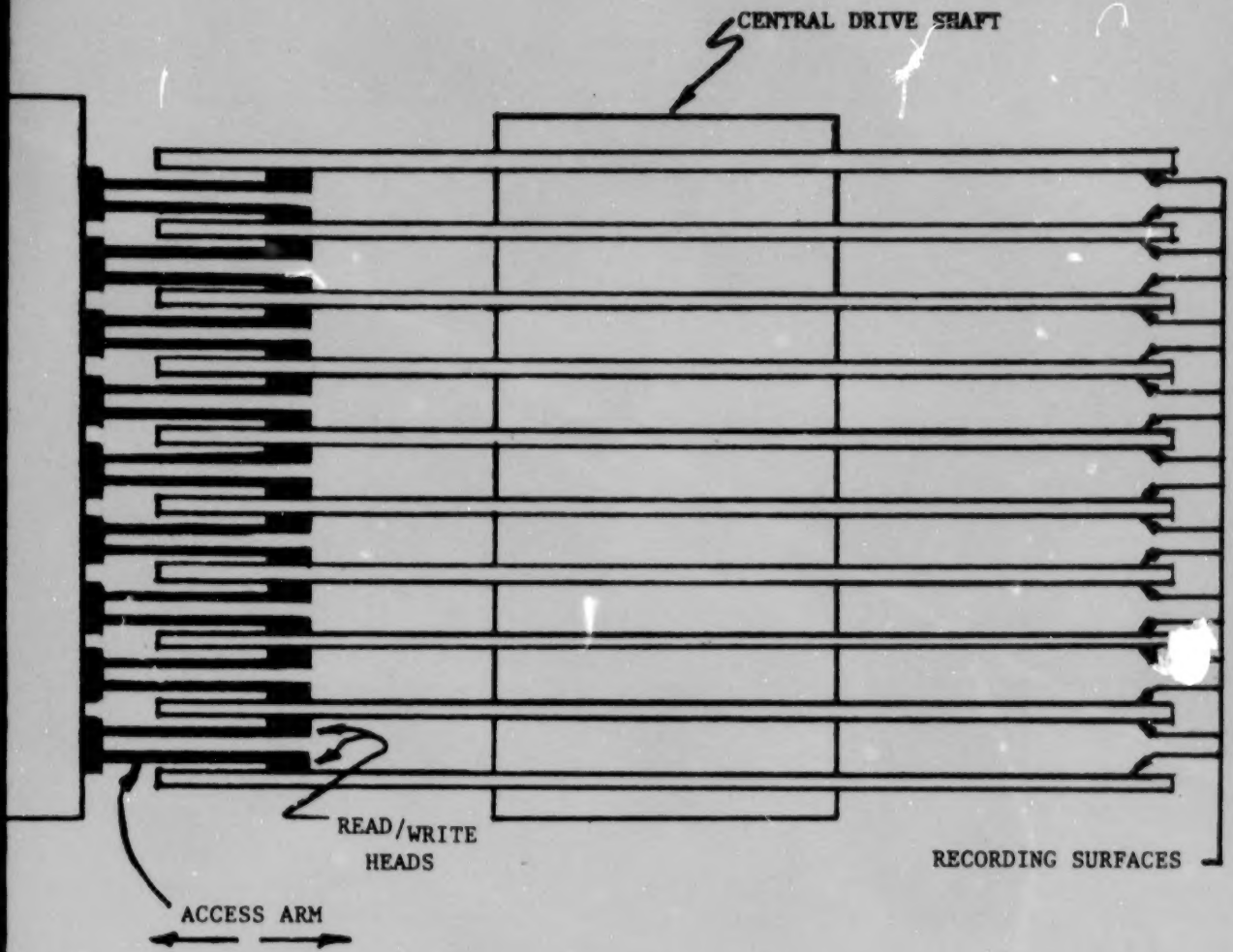

Illustration #4

d. A magnetic disk pack is made up of several of these metal platters which are stacked on top of each other and are held together by a Central Drive Shaft. See Illustration #4

e. The top surface of the top platter is not recorded on, but instead is used as protection for the other recording surfaces. The same thing is true for the bottom surface of the last platter. The rest of the surfaces are used for storing data which are read or written by the read/write heads.

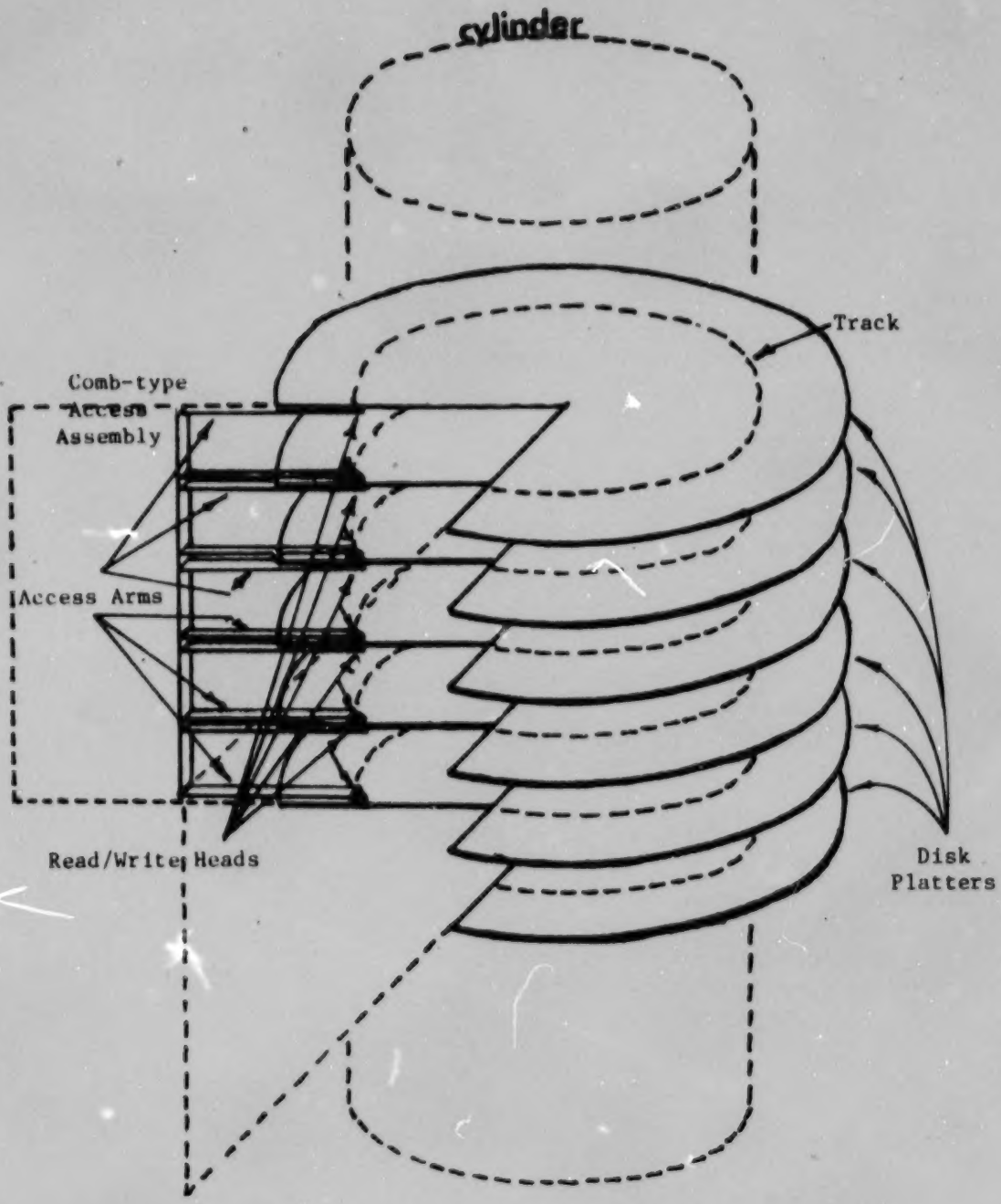

Illustration #5

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2. Distinguish Between Tracks and Cylinders:

a. Whenever one read/write head is positioned on a certain track on a recording surface, all the other read/write heads are on that same track position for its recording surface. This is due to the fact that all the heads move back and forth at the same time.

The group of tracks at the same head position is called a cylinder. See Illustration #5

b. In our example, we now can have 203 cylinders because each recording surface has 203 tracks.

The numbering of these tracks and cylinders gives the computer the ability to position the read/write heads at any given area on the disk pack. In turn, the computer now has the ability to skip over data records which are not required.

3. Function of the Volume Table of Contents (VTOC):

Let's see how the computer can skip over this data that is not required.

For this example, we will say that the computer needs to find Pvt. Jones' pay record on the payroll disk file.

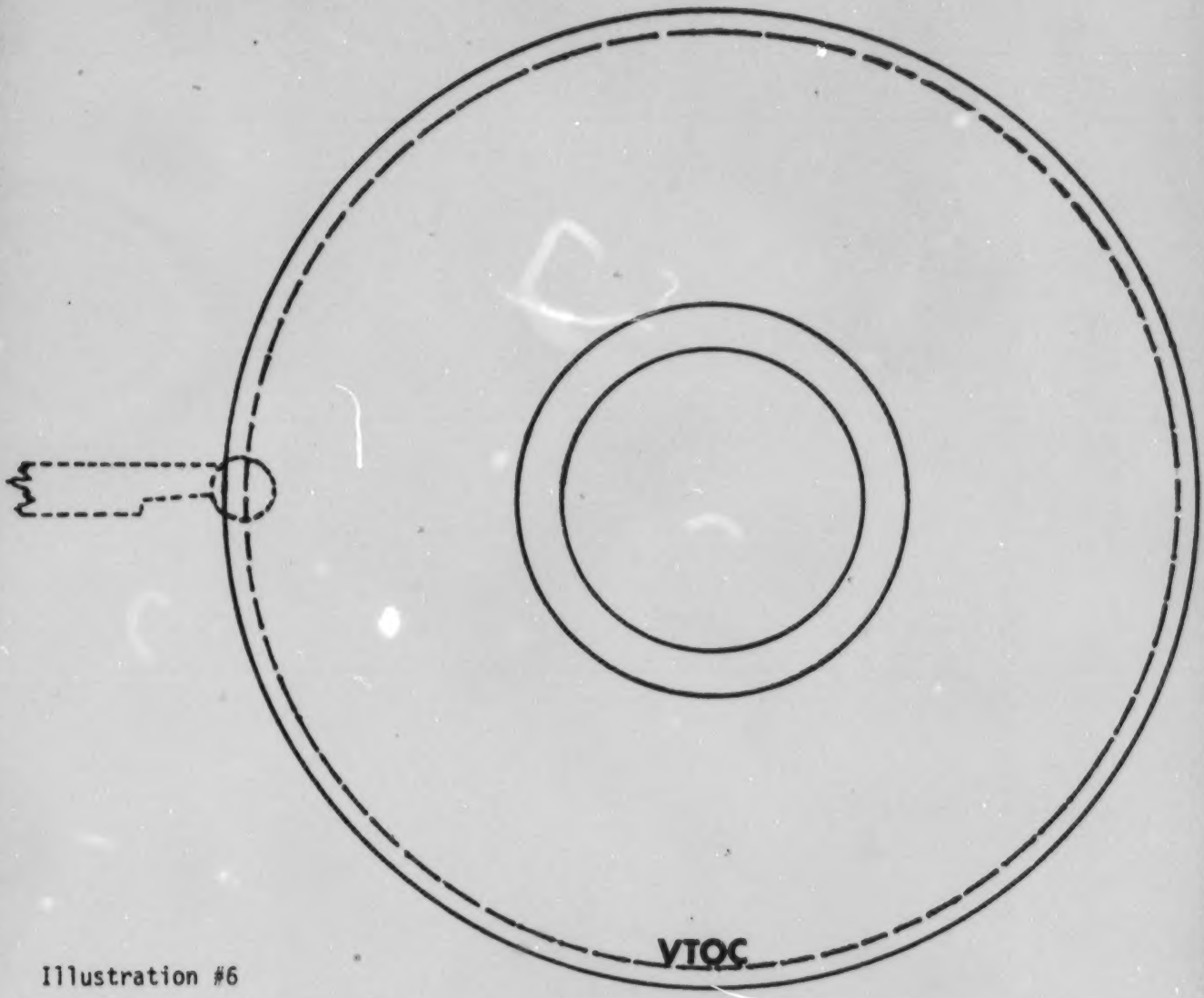

Illustration #6

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a. The first thing the computer would do is to go to a particular cylinder that would contain the Volume Table of Contents (VTOC). See Illustration #6

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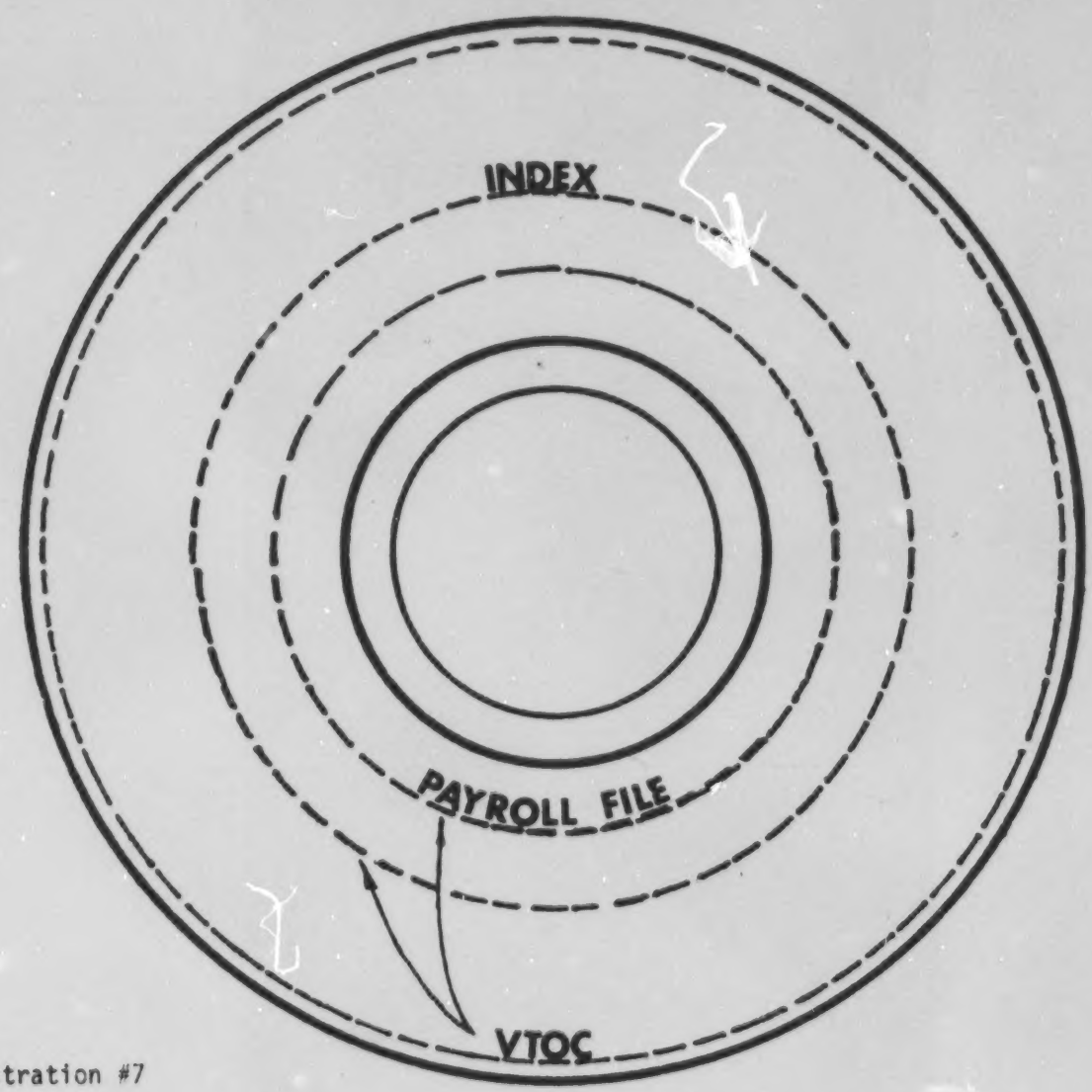

Illustration #7

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In this VTOC, there will be the information that would tell the computer if the payroll file is located on that pack and where the index for the people on the payroll file is located.

See Illustration #7

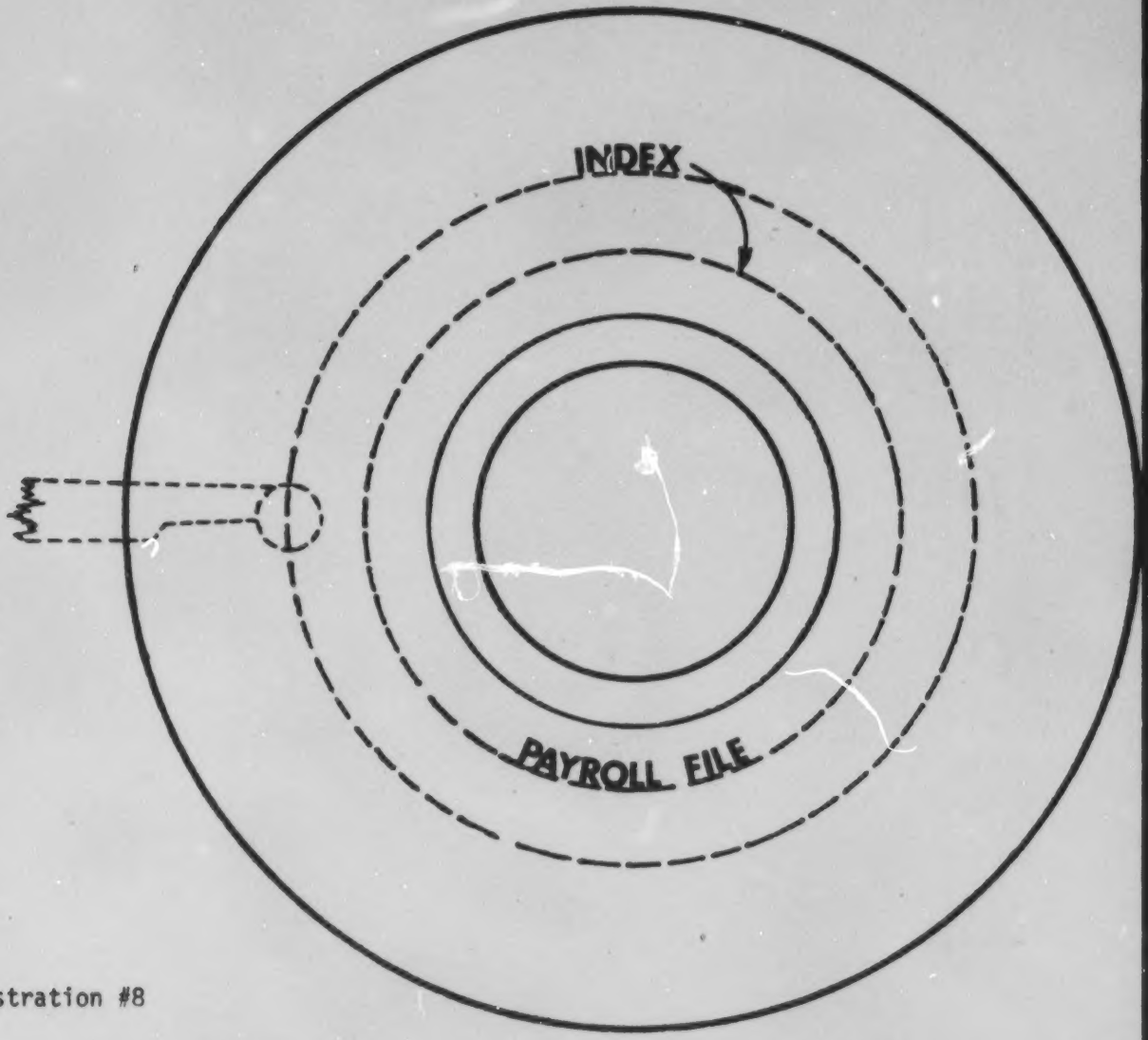

Illustration #8

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b. The computer will tell the read/write heads to go to the index area and in turn, this area would be able to tell the computer what area or cylinder on the disk pack that Pvt. Jones' pay record is located.

See Illustration #8

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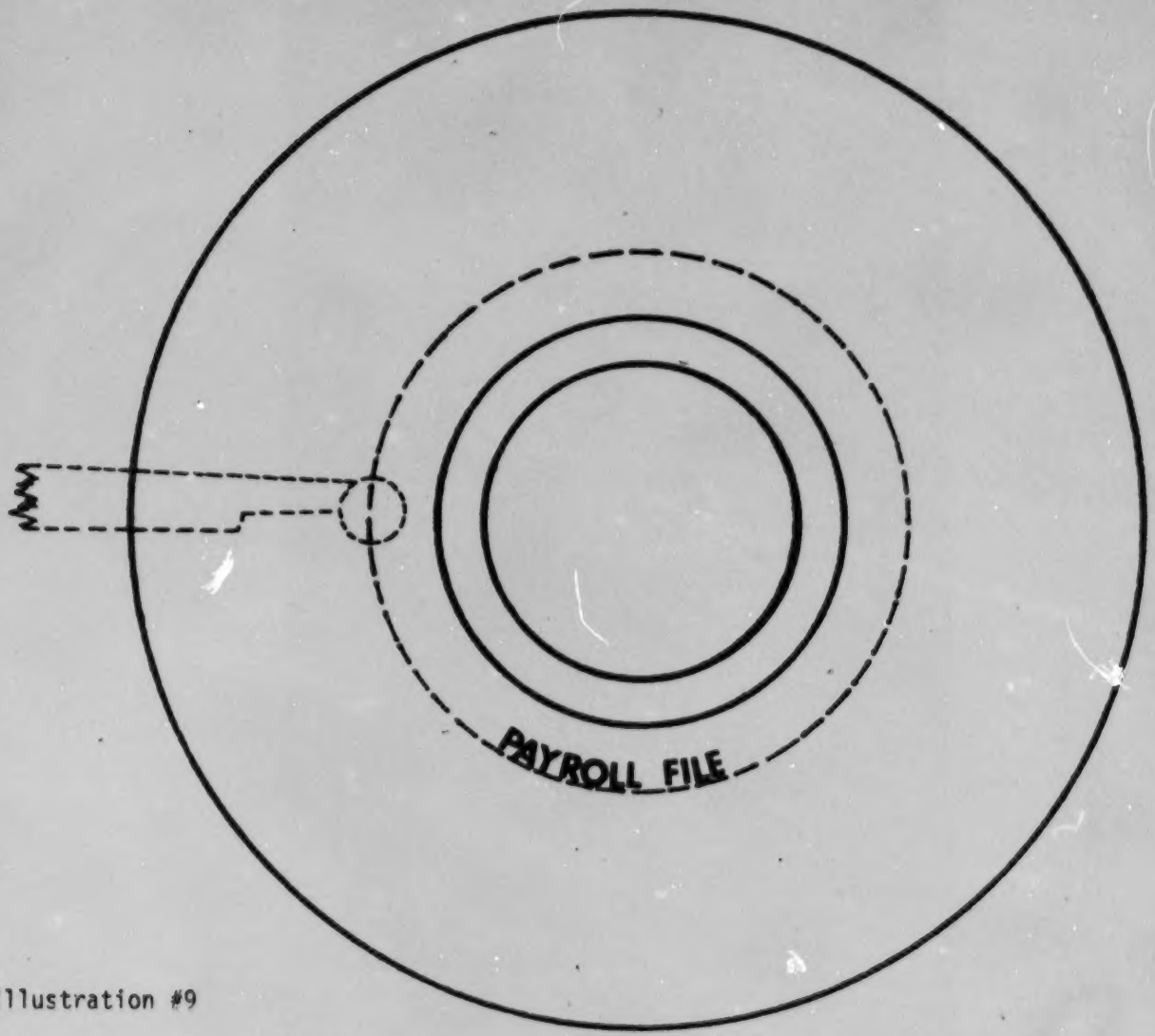

Illustration #9

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c. The computer then would move the read/write heads to that particular cylinder. (i.e. cylinder 100). See Illustration #9

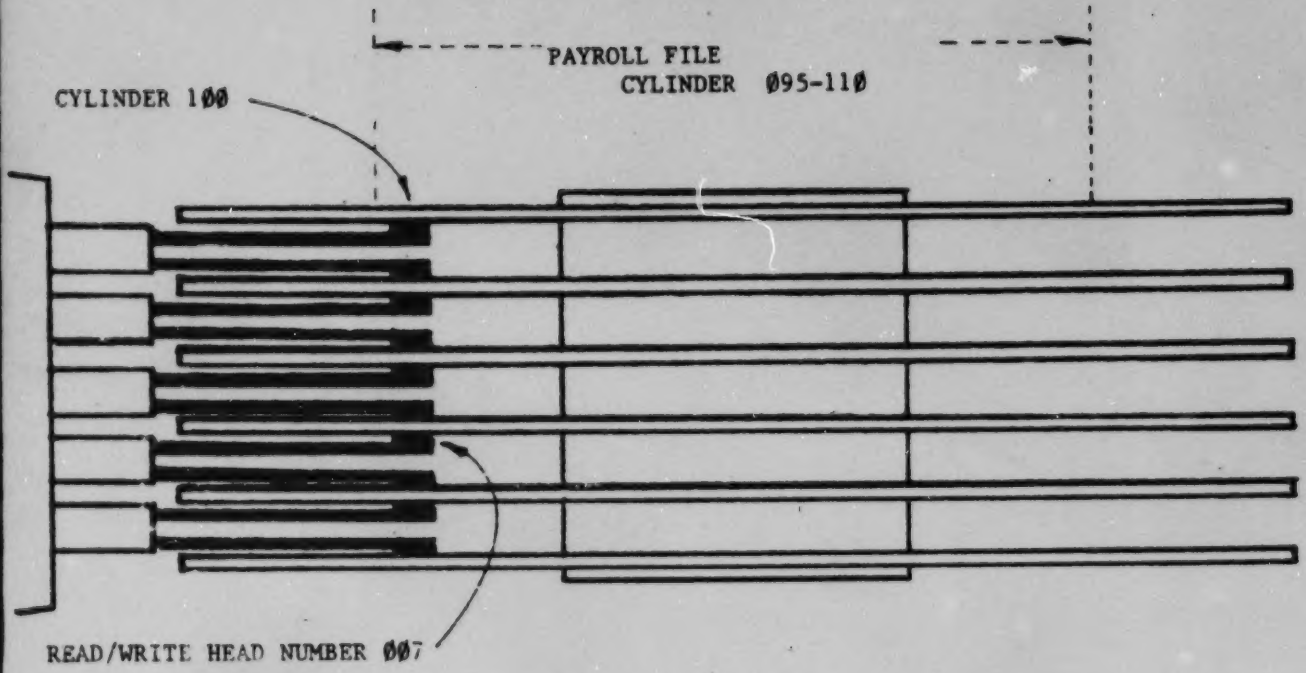


Illustration #10

d. When the read/write heads, get positioned at cylinder 100, there would be another label or index there that would tell the computer that the pay record of Pvt. Jones can be accessed by head #7. See Illustration #10

e. The computer will then request read/write head #7 to read all records on the track until Pvt. Jones' pay record has been read. This reading will take place as the disk pack revolves at a high speed.

f. Once Pvt. Jones' pay record is read, the read/write head will stop reading data records.

4. Volume Serial Number.

As a computer operator, it is your duty to insure that the correct disk pack is mounted. This is done through the use of the computer run instructions.

The computer run instructions will specify a certain disk pack through the use of the Volume serial number. Each disk pack has a unique Volume serial number usually consisting of six alph-numeric characters that is written as an outside lable (external label) to enable the operator to determine which particular disk pack is required. The same Volume Serial Number is also coded in magnetic bits in the disk pack which will tell the computer which disk pack is mounted and enables the computer to distinguish between disk packs presently mounted on the disk drives.

So far, in this block of instruction, we have discussed:

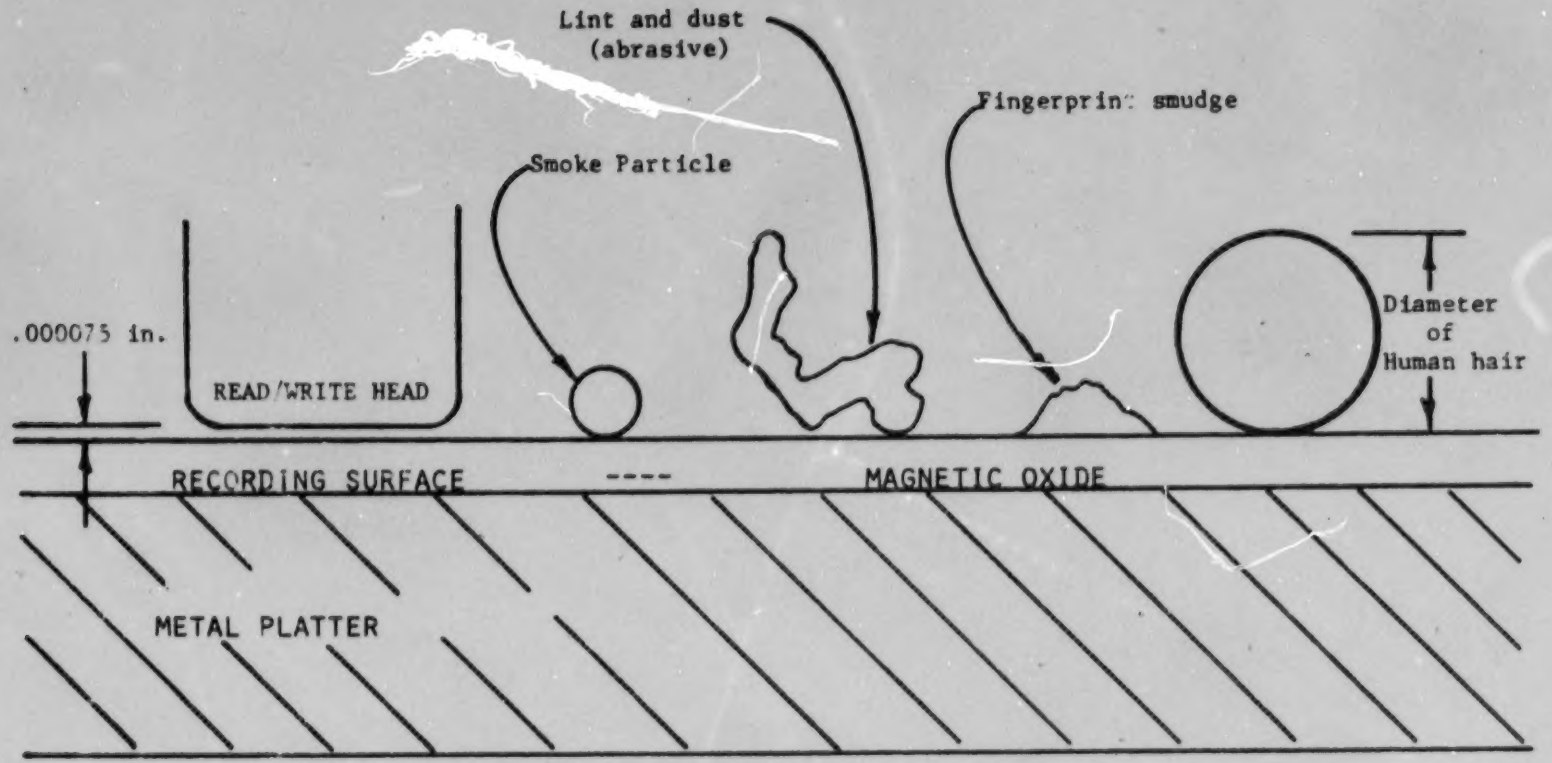
a. How the writing of data on a disk pack creates data tracks and cylinders.

b. How the computer, by using VTOC's and indexes can skip over data records that are not required.

c. By using computer run instructions, how you as an operator can insure that the correct disk pack is mounted on a disk drive.

d. How the computer, by checking a Volume serial number, can identify each disk pack that is mounted.

But none of this can take place if you do not take the proper procedures in the care of the environment of the computer room.



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01-05-29

GAP BETWEEN RECORDING SURFACE OF MAGNETIC DISK & READ/WRITE HEAD
COMPARED TO OTHER PARTICLES

Illustration #11

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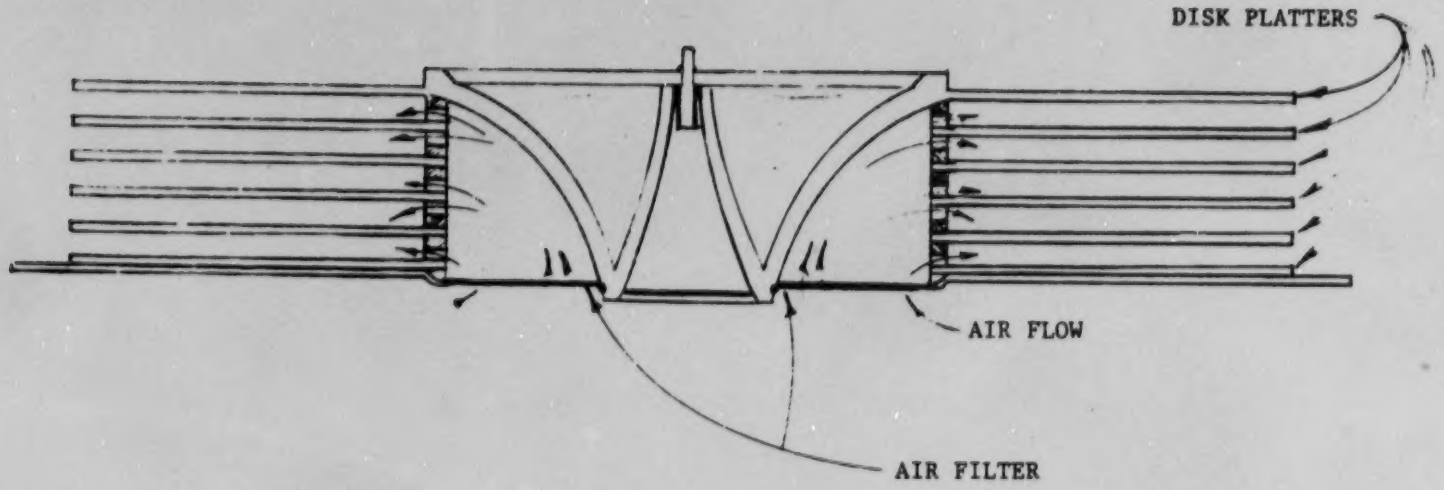
5. Conditions which Effect the Recording Capaiblities of Magnetic Disk.

As previously mentioned, the disk pack rotates at high speeds (i.e. approximately 2400 RPM). At this high rotational speed, if the read/write head was to make contact with the recording surface (oxide coating), an error condition would occur. This condition is commonly referred to as a head crash. This happens when the disk pack is warped in the slightest way due to temperature changes (expansion or contraction), improper handling or shipping of the disk pack, or contaminated computer room environment.

The read/write head's distance from the disk surface is about 0.000075 of an inch. In comparison, a speck of dust or a smoke particle is very large and can actually cause a head crash, or data error. See Illustration #11



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01-05-29

Illustration #12

The disk pack, spinning at a high speed solves part of the problem of keeping the dust off the recording surfaces of the pack, by creating an airflow. This air flows through a filter located at the bottom of the disk pack. The filter is there to help free the disk pack of contamination. The air is directed to the surface of each platter by the use of vents between the platters of the disk, and tries to force the dust off the platter of the disk. Depending on your installation, you might be required to occasionally inspect and even change the filter of the disk pack. Be sure to check your unit's Standard Operating Procedures on how to go about this if you have to change the Air Filter.

See Illustration #12

However, because of the need to keep the disk pack environment clean, this air flow does not solve the whole problem, it will be your responsibility to insure that the computer room is kept as clean as possible.

In this block of instruction, we have discussed the characterisitics of Magnetic disk and those conditions that effect the recording capabilities of magnetic disk.

One of the functions of a computer operator is handling of magnetic disk packs. A knowledge on how it works give you valuable insight that is expected of a good computer operator.

SELF-EVALUATION

1. True or False. The magnetic disk must read all the records on a file in order to read the last record. _____

2. True or False. The magnetic bits that represent data are read by the read/write head. _____

3. True or False. When a magnetic disk is being used it is placed on a device called a disk drive. _____

4. True or False. The circle of data recorded on a disk is called a drum. _____

5. A disk pack can have:

   a. 150 tracks
   c. 203 tracks
   b. 240 tracks
   d. 198 tracks

6. True or False. The upper surface of the top platter of a disk pack is used to record data. _____

7. True or False. The bottom surface of the last platter of a disk pack is used as protection for the other recording surfaces. _____

8. True or False. All the read/write heads move at the same time. _____

9. True or False. A group of tracks at the same head position is called a drum. _____

10. True or False. The Volume Table of Contents (VTOC) tells the computer where a file is located on the disk pack. _____

11. True or False. Each disk pack has a unique volume serial number. _____

12. True or False. Temperature changes do not affect the disk pack. _____

13. True or False. The distance between the disk pack's surfaces and the read/write heads is so large, a speck of dust on the disk's surface will cause no problem. _____

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ANSWER KEY

1. False
2. True
3. True
4. False
5. c.
6. False
7. True
8. True
9. False
10. True
11. True
12. False
13. False

01-07-29

US ARMY INSTITUTE OF ADMINISTRATION
Fort Benjamin Harrison, Indiana 46216

CHANNELS, CONTROL UNITS AND PHYSICAL ADDRESSES

Prepared for: Computer/Machine Operator Course

Prepared by: Hardware Division, Data Processing Department

October 1978

STUDENT NAME: _____

CLASS NO. _____

FOR INSTRUCTIONAL PURPOSES ONLY

INTRODUCTION

Up to this point in the course you have become familiar with the Central Processing Unit and the various peripheral devices (I/O devices). During the next block of instruction, you will learn how a Central Processing Unit is connected to these devices to create an efficient computer system. You will be taught:

a. How special purpose computers called channels help make the computer system more efficient.

b. How I/O Control Units solve the problem of I/O device language being different than the CPU language.

c. How physical addresses help the computer identify each I/O device.

As future computer operators your becoming familiar with how Data Processing Equipment make up a computer system will give you valuable insight, and will increase your confidence as a computer operator.

1. Channels: Previously you learned how the Central Processing Unit and the Input/Output devices operate. If you can recall, a Central Processing Unit operating in speeds of millionths of a second is not uncommon. Also, remember that I/O devices operate in speeds that are measured in minutes and thousandths of a second; this is slow in comparison to the CPU. Let us take a single task for example. The CPU wishes to command the card reader to read a card and write the information on a magnetic tape. In the past, the CPU would:

(1) give its read a card command to the card reader,

(2) wait for the card reader to read at its slow rate,

(3) transfer the data to the tape drive, and

(4) wait for the tape drive to write the data on the magnetic tape.

Then this cycle would be repeated if there were more cards to be read. During the time the card reader is reading the card and the tape drive is writing the data on the tape, the CPU would be waiting. This waiting is commonly referred to as an idle state. Since the card reader and the tape drive are slow devices in comparison to the CPU, the CPU would be idle a large amount of time, since much of the processing involves I/O operations by the card reader and the tape drive. This is normally true in all data processing jobs. Most of the processing consists of I/O activity instead of CPU activity. This can result in a less efficient use of the CPU. To reduce the amount of CPU wait time, channels were developed.

Illustration #1

Channels, are basically small special purpose computers which relieve the CPU of the burden of controlling I/O operations. Once the CPU instructs the channel to perform I/O operations, the CPU can now return to normal processing. It can start another input operation or resume processing data for that job, or even start processing data for another job. More than one set of input and output devices can be connected to channels, and through concurrent processing and I/O operations, the computer can appear to be doing more than one job at once. Now back to our example. The CPU gives the channel the instruction to read a card, now the channel responds and the CPU can give a different channel the task of writing the data on the tape. So, while the card reader is reading a card, the tape drive can be writing the data from a card that was previously read. Now (for all practical purposes), we have two things going at once since the channels are performing I/O tasks. Also, the CPU has been freed to process a portion of another job while the I/O operations of reading the card and writing the data on the magnetic tape are being accomplished. As a result, the time to run a job can be reduced, and the amount of time available for processing of data has increased.

see illustration #1

2. Channel Types: There are two types of channels which can be distinguished by the way they operate.

The Selector channel will work with one device until the complete record is written to the device.

A Multiplexor channel can work with several devices at one time.

The Selector channel is always attached to high speed I/O devices.

The Multiplexor channel is normally attached to low speed devices.

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3. Interface and Control Units: In the past another limitation on CPU processing time was due to the fact that each type of I/O device required a different series of control signals for its operation. Today many different types of devices can be attached to the Central Processing Unit without the CPU giving different types of instruction for each device. This is due to the concept of standard interface.

see illustration #2

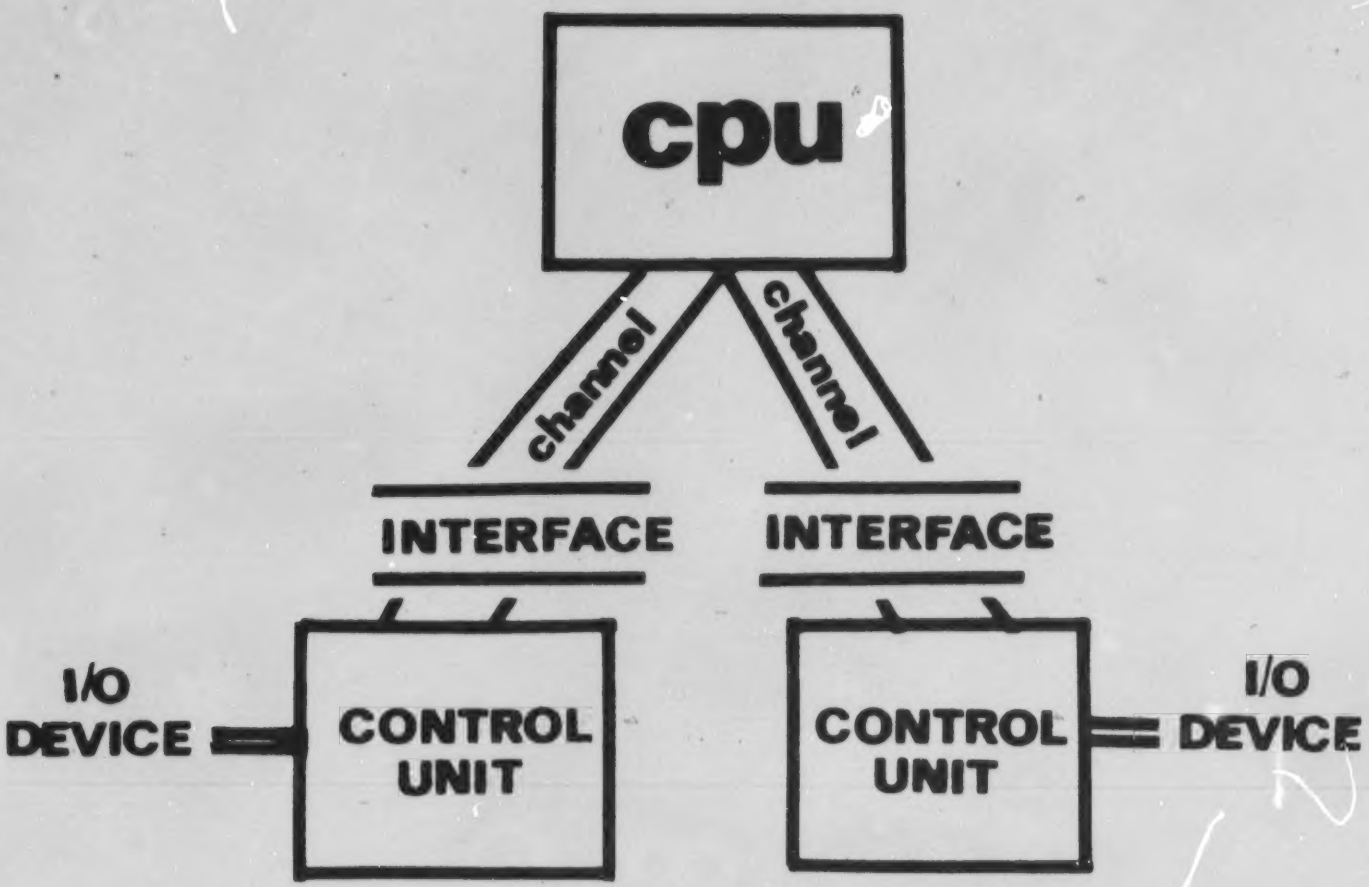

Illustration #2

The I/O interface is formed by an I/O control unit and a channel which sends out standard I/O commands.

A Control Unit is a device connecting an I/O device to a channel.
Any type of I/O device whose control unit is designed to respond to the standard signals available at the I/O interface may be attached to the system. The control unit translates these standard commands into signals the I/O device can understand. The standard interface is at the control unit. Any device with a control unit that can respond to the standard signals of the system can be used. Each time a new device is developed the only requirement for attachment to the system is that it has the capability to respond to standard signals of the channel.

see illustration #3

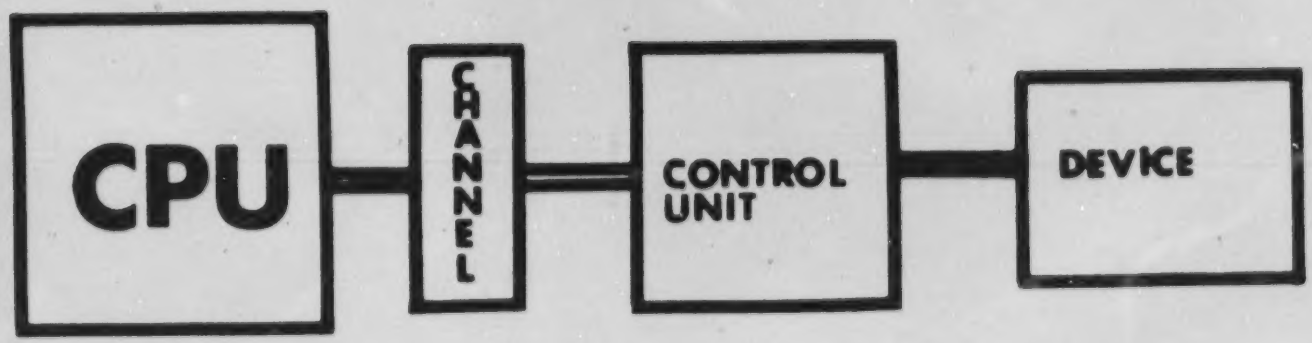

Illustration #3

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4. Physical Addresses: We have talked about channels, control units and devices and how they operate and their function in the computer system when the Central Processing Unit wishes to command them to perform an I/O function.

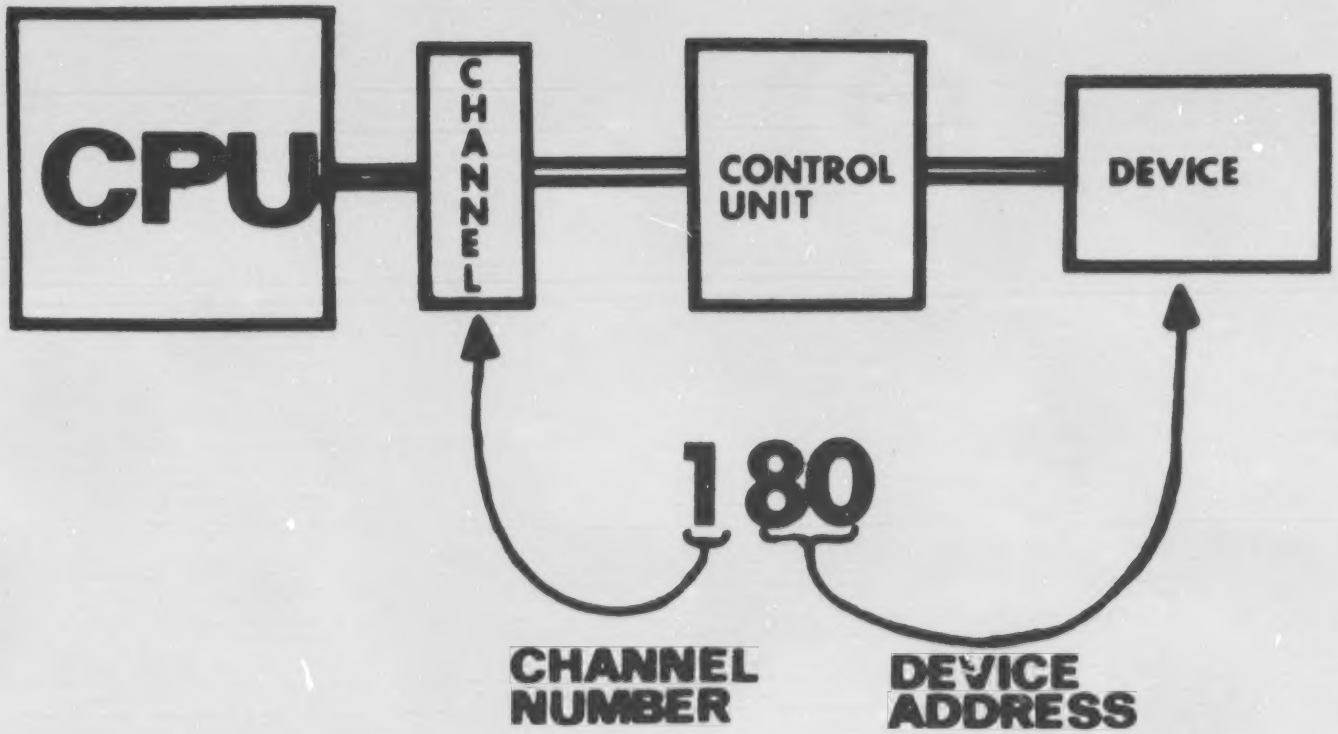
For example, it wants a tape drive to write a record on magnetic tape. But what happens if we have six tape drives connected to the computer system? There must be a way to ask for a particular tape drive to write the data. This is accomplished by the use of an address. The channels and devices are numbered using the hexidecimal numbering system. The hexidecimal numbering system is base sixteen instead of base two as the binary numbering system. In the hexidecimal numbering system, numbers 0 thru 9 remain 0 thru 9. Numbers 10 thru 15 are represented by characters A thru F. Refer to chart number 1. See Chart 1

CHART #1

DECIMAL	HEXIDECIMAL
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	A
11	B
12	C
13	D
14	E
15	F

The computer system uses a table which includes all the addresses of physical units (I/O devices) attached to the system. This table is called a Physical Unit Block (PUB). The Central Processing Unit refers to this table to check if a requested address is valid and if the device is available. The address is three positions in length. The first position is the number of the channel that the control unit of the I/O device is attached to. The second and third positions are the number of the I/O device. If we have an address of 180, the see one is the number of the channel and the eighty is the number of the I/O device.

see illustration #4



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01-07-29

Illustration #4

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CHART #2

ADAM	Physical Unit Address
CR0	00C (Card Reader)
PR0	00E (Printer)
CP0	00D (Card Punch)
TP0	180 or 280 (Tape Drive)
TP1	181 or 281
TP2	182 or 282
TP3	183 or 283
TP4	184 or 284
TP5	185 or 285
DK0	130 (Disk Drive)
DK1	131
DK2	132
DK3	133
DK4	134
DK5	135
DK6	136
DK7	137

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5. Automatic Device Assignment Method: Each device in the computer room is given a unique address determined by its device number and channel number. The Army has many installations located worldwide which use the same programs. These programs are designed to use the same number of devices regardless of the total number of devices in the installation. As long as the installation has the appropriate number of devices needed by the program, the program can be used. Some installations have different addresses for their devices. One installation may have their tape drives connected to channel number one, while other installations may use channel number two. The Army uses the Automatic Device Assignment Method (ADAM) to standardize all device addresses. Refer to the example. The addresses on the left are the addresses used by ADAM. The addresses on the right are the addresses for the devices in the school. Refer to Chart #2.

see Chart #2

6. During this past hour we have discussed the functions and characteristics of channels, standard interface, control units and physical unit addresses.

a. Channels relieve the CPU of I/O control by acting as a special purpose computer performing I/O processing. The CPU is freed of this task and is now available for processing. This results in efficiency, and less time that will be required to run a job.

b. Standard interface allows the computer system to use standard I/O commands.

c. Control units translate standard commands given by the channel.

d. Physical unit addresses are used as a means of determining location of a device attached to the computer system.

e. The Automatic Device Assignment Method (ADAM) address is used by the Army to identify physical I/O devices.

7. As a computer operator you will be working with these devices and concepts daily. Knowledge of these devices and concepts will help you become a good computer operator.

SELF-EVALUATION

1. True or False. The CPU and I/O devices operate at the same speed. _____

2. True or False. Channels are basically special purpose computers. _____

3. True or False. In Data Processing, the amount of I/O activity and CPU activity for most jobs is the same. _____

4. True or False. Channels help reduce CPU wait time. _____

5. True or False. Only one device may be attached to a channel. _____

6. True or False. The channel selects and executes standard I/O commands. _____

7. True or False. Channels are either the multiplexor or selector type. _____

8. True or False. The ability to use so many different I/O devices is the concept of standard interface. _____

9. True or False. The control unit translates the signals of the channel into signals the I/O device can understand. _____

10. True or False. Any I/O device with a control unit that can respond to the standard signals of the system can be utilized. _____

11. True or False. The buffer works as an equalizer for high speed processing and high speed devices. _____

12. True or False. In an address of 184, one is the device number and 84 is the channel number. _____

13. True or False. In an address of 236, the two is the channel number and 36 is the device number. _____

14. True or False. Physical addresses are the addresses of I/O devices. _____

15. True or False. The ADAM address of TP2 represents the same device as 182 would represent.

ANSWER KEY

1. False
2. True
3. False
4. True
5. False
6. True
7. True
8. True
9. True
10. True
11. False
12. False
13. True
14. True
15. True

01-02-30

US ARMY INSTITUTE OF ADMINISTRATION
Fort Benjamin Harrison, Indiana 46216

Job Control Language

Prepared for: Computer/Machine Operator Course

Prepared by: Hardware Division, Data Processing Department

October 1978

STUDENT NAME: _____

CLASS NO. _____

FOR INSTRUCTIONAL PURPOSES ONLY

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INTRODUCTION

Have you ever wondered what tells the computer when to run a program, what program to run, where to get all the input it needs and where to put the output it creates?

The answer to this is job control language.(JCL). The understanding of JCL will be beneficial to you as a computer operator. JCL is used in everyday computer environment, and without JCL the link between the program and computer will be virtually impossible.

At the end of this block of instruction you will be given a list of JCL statements. You will be able to select the proper function of that JCL statement.

1. PREVIOUS BLOCK RECAP:

In the previous instructions, you've learned how application programs use main memory to solve a given problem and how the programer uses logical units for input and output.

In the instruction on channels, control units and physical address, you've learned about physical unit addresses of the actual unit or device.

Logical units refer to an input or output device, and is characterized by "SYS" and 3 alpha-numeric characters. On the other hand, a physical unit address is the actual device and is characterized by a 3 alpha-numeric address.

Example:

Logical Unit: SYS016 Physical Unit Address: TP2

If you remember, the computer has to be told what physical devices are to be used by the program in order to meet it's input/output requirements. The computer will also have to be told when the program is to be brought into memory and ran. These instructions are received by the computer through the Job Control Language or JCL.

2. PURPOSE OF JOB CONTROL LANGUAGE:

JCL provides instructions to the computer that will request a program or several programs from the program library and will determine the physical devices that will be used by the computer when running the program or programs. In other words, JCL is the communication link between the computer and the program.

In this block of instruction, we will see how JCL serves as the communication link between the computer and the program. Let's look at the problem of data input from cards that need to be read by the card reader, and then that data will be written to magnetic tape on a particular tape drive.

What are the program requirements?

3. PROGRAM REQUIREMENTS:

a. What is the program name?

b. What type of input media will I be using?

c. What type of output media will I be using?
What is the file-name going to be?

d. What logical unit am I going to use for the input media?

e. What logical unit am I going to use for the output media?

f. Do I read all the input media?

g. What do I do when I'm done reading?

In order to satisfy the program requirements, we must give the needed requirements an answer.

a. The program name is P19HRD.

b. The input media will be on cards.

c. The output media will be on magnetic tape.
The file-name is E19HRD.

d. The logical unit to be used by the input media is SYS016.

e. The logical unit to be used by the output media is SYS006.

f. Read the card input from logical unit SYSO16
Write that input record to logical unit SYSO06.
Was that the last input record?
If not, go back to the beginning of step F.

g. All cards are read, End The Program.

What are the computer requirements?

4. COMPUTER REQUIREMENT:

a. We have to tell the computer that we are going to run a job.

b. We have to tell the computer what device we are going to use for our input.

c. We have to tell the computer what device we are going to use for our output, and the data-set name of our output.

d. We have to tell the computer to begin processing the program.

e. We have to tell the computer that the last input card has been read.

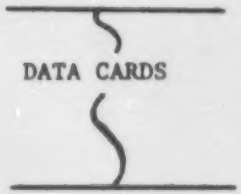
f. We have to tell the computer that the job is finished.

** DATA-SET-NAME: Is the name written to output magnetic media by the computer. This name is supplied by the JCL. This name cannot be more than 17 alphanumeric characters in length. (Normally, on Army standard systems, they will consist of 6 alpha-numeric characters.

With JCL, we can give the computer specific instructions on how and when our program is to be run.

In order to show you, how JCL works, let's now link the program with the computer.

First, let's look at the computer requirements.....

PROGRAM REQUIREMENTS	JCL	COMPUTER
1.	// JOB CARD-TO-TAPE	I AM GOING TO RUN A JOB CALLED "CARD-TO-TAPE.
2. THE INPUT MEDIA WILL BE ON CARDS THE LOGICAL UNIT TO BE USED IS "SYSØ16"	// ASSGN SYSØ16,X'CRØ'	WHENEVER A PROGRAM NEEDS LOGICAL UNIT "SYSØ16", I AM GOING TO USE THE PHYSICAL UNIT "CRØ"
3. THE OUTPUT MEDIA WILL BE ON MAGNETIC TAPE, THE LOGICAL UNIT USED IS "SYSØØ6"	// ASSGN SYSØØ6,X'TP2'	WHENEVER A PROGRAM NEEDS LOGICAL UNIT "SYSØØ6", I AM GOING TO USE PHYSICAL UNIT "TP2".
4. THE FILENAME IS E19HRD.	// TLBL E19HRD, 'PAYMST'	WHEN FILENAME "E19HRD" IS USED, I WILL WRITE THE DATA-SET-NAME "PAYMST" TO THE HEADER RECORD OF THE TAPE.
5	// EXEC P19HRD	I AM GOING TO GET THE PROGRAM "P19HRD" FROM THE PROGRAM LIBRARY AND LOAD IT TO MAIN MEMORY AND DO THE PROGRAM INSTRUCTIONS.
6. READ THE CARD INPUT FROM THE LOGICAL UNIT "SYSØ16".		I AM GOING TO READ A CARD FROM PHYSICAL DEVICE "CRØ"
7. WRITE THAT INPUT RECORD TO LOGICAL UNIT "SYSØØ6"		I AM USING FILENAME "E19HRD", SO THE FIRST THING I MUST DO IS WRITE THE DATA-SET-NAME "PAYMST" TO THE HEADER RECORD.
8. IS IT THE LAST CARD?	/*	THERE ARE NO MORE CARDS ON "CRØ"
9. END THE PROGRAM "P19HRD"		I AM ALL THROUGH WITH"P19HRD". JCL WHAT AM I TO DO NOW?
10.	/& (END OF JOB)	I AM ALL THROUGH WITH JOB"CARD-TO-TAPE".

5. COMPUTER REQUIREMENTS AND PROGRAM REQUIREMENTS:

a. We have to tell the computer that we are goingto run a job.

(As mentioned earlier, job name is CARD-TO- TAPE.)

```
// JOB CARD-TO-TAPE
```

Tells the computer that we are going to run a job called "CARD-TO-TAPE".

Next, we have to look at the program and the computer requirements regarding input and output devices.

b. The program states that the input media will be on cards and the logical unit to be used by the input media is SYS016.

```
// ASSGN SYS016,X'CR0'
```

Tells the computer that whenever a program needs logical unit SYS016, to use phyical unit CR0.

c. The program states that the output media will be on Magnetic tape and the logical unit to be used is SYS006.

```
// ASSGN SYS006,X'TP2'
```

Tells the computer that whenever a program need logical unit SYS006, to use the physical unit TP2.

d. The program states that the output filename will be E19HRD.

We have to tell the computer that the program is going to have a data-set name of PAYMST.

```
// TLBL E19HRD,'PAYMST'
```

Tells the computer that when the filename E19HRD is used, to write the data-set-name 'PAYMST' to the header record.

e.

```
// EXEC P19HRD
```

Tells the computer:

(1) To get program P19HRD from the program library

(2) To load the program to main memory

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(3) To do the program instructions

f. The program states; to read the input from logical unit SYS016.

This tells the computer to read a card from the card-reader CR0.

g. The program states; to write that input record to logical unit SYS006.

This tells the computer to write the card-record to the tape on TP2.

h. /*

Tells the computer that the last card had been read.

i. The program states; that once the last card has been read, to end program P19HRD.

Tells the computer that program P19HRD has been completed.

Now the only thing that need to be done is to tell the computer that the job is done.....

j. /&

Tells the computer that the job "CARD-TO-TAPE" is done.

There are two more JCL that we'll cover, and that is the DLBL and the EXTENT statements.

The DLBL like the TLBL statement, tells the computer that when the filename specified is used, it will have the data-set-name specified to the VTOC of the disk. (Volume Table of Contents)

Example: // TLBL E19HRD,'PAYMST'

If the output of the program we just ran is placed on disk instead of tape, it would look like this.....

// DLBL E19HRD,'PAYMST'

The EXTENT statement tells the computer on which disk the data will be written to, and on what area on that disk the file is going to be on.

Example: // EXTENT SYS006 111111,,,200,50

Tells the computer that the logical unit SYS006 is going to be on the disk pack with the volume serial number 111111, and the area specified as track 200 to track 250.

6. DIFFERENTIATING BETWEEN A JOB AND A JOB STEP:

If we have several programs to run in one job, each program to be run is known as a job step and is characterized by the // EXEC statement.

```
EXAMPLE:  // JOB CARD-TAPE-DISK
          // ASSGN SYS016,X'CR0'
          // ASSGN SYS006,X'TP2'
          // TLBL E19HRD,'PAYMST'
          // EXEC P19HRD            job step P10HRD
                data cards
JOB
          /*
          // ASSGN SYS014,X'TP2'
          // TLBL E19HRD,'PAYMST'
          // ASSGN SYS006,X'DKI'
          // DLBL E19HRD,'PAYMST'
          // EXTENT SYS006,111111,,,200,50
          // EXEC P20HRD            job step P20HRD
          /&
```

7. RESPONSIBILITY OF THE COMPUTER OPERATOR IN REGARDS TO JCL:

As a computer operator, you have to enter these JCL statements to the computer system by means of the card reader or through the console typewriter. You are not responsible for the contents of the JCL deck, but you have to make sure that the deck is complete, this is done by using a listing provided by the programer.

8. SUMMARY:

In this course of instruction, we have discussed how JCL serves as a link between the program and the computer.

// JOB	Tells the computer the Job Name.
// ASSGN	Tells the computer, that a specified logical unit is assigned to a specific physical device.
// TLBL	Tells the computer the program filename and data-set-name of the tape.
// DLBL	Tells the computer the program filename and data-set-name for the disk files.
// EXTENT	Tells the computer on which disk and on what area of that disk a particular file is going to be on.
// EXEC	Tells the computer the program to be executed. (indicates a JOB STEP)
/*	Tells the computer that the last record of the input data records has been read.
/&	Tells the computer that the job is finished.

As a computer operator, you will be dealing with JCL on a daily basis. A knowledge of JCL will enable you to identify basic JCL errors and will enable you to do your part as an operator to insure the computer job 0045 is completed on time.

END

SELF EVALUATION

1. True or False. JCL is the communication link between the computer and the program. _____

2. True or False. A data set name is the name written to output media by the computer. _____

3. True or False. The // Job statement tells the computer the Data Set name. _____

4. True or False. The // ASSGN statement tells the computer the Job name. _____

5. True or False. The // TLBL statement tells the computer the program file name and data-set-name of the tape. _____

6. True or False. The // DLBL statement tells the computer the name of the program file name and data-set-name of the tape. _____

7. True or False. The // EXEC statement tells the computer which devices will be used. _____

8. True or False. The // EXTENT statement tells the computer on which disk and on what area of that disk a particular file is located. _____

9. The /* statement tells the computer:

   a. the job has ended

   b. the last input record has been read

   c. to read a file

   d. to write a file

10. The /& statement tells the computer:

   a. the file was read

   b. to start execution of a job

   c. the job is finished

   d. the name of a file

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ANSWER KEY

1. True
2. True
3. False
4. False
5. True
6. False
7. False
8. True
9. b.
10. c.

01-03-30

US ARMY INSTITUTE OF ADMINISTRATION
Fort Benjamin Harrison, Indiana 46216

CONCEPTS IN COMPUTER PROCESSING

Prepared for: Computer/Machine Operator Course

Prepared by: Hardware Division, Data Processing Department

October 1978

STUDENT NAME: _____

CLASS NO. _____

FOR INSTRUCTIONAL PURPOSES ONLY

INTRODUCTION

This block of instruction is designed to introduce you to the concepts of running a job in a computer. In this lesson you will be introduced to:

a. Disk JCL

b. Job Streams

c. Single program and multiprogramming processing

d. Memory area distribution

e. Memory area priority

f. Memory area identifiers

The importance of the material in this block of instruction cannot be expressed enough. You should review this material until you fully understand all the material in this lesson. The concepts being presented in this lesson are the basics of running a job which is to be your job as a computer operator.

SINGLE STEP JOB

```
// JOB CARD TO TAPE
// EXEC CARD TO TAPE
/*
/&
```

3 STEP JOB

```
// JOB PAY-UPDATE
// EXEC P19HRD      -- JOB STEP 1
// EXEC P21HRD      -- JOB STEP 2
// EXEC P22HRD      -- JOB STEP 3
/*
/&
```


Illustration #1

1. Job Steps: In the previous block of instruction you learned that a job can be a one-step (program) job. An example of a single-step job is the card to tape program where the only thing that is required of the job is to load data cards to magnetic tape. You also learned that several job steps (programs) can be in a job. Let's take a payroll job for example. The requirement of a payroll job may be to update the payroll files.

See Illustration #1

a. The first step may be to load the payroll cards to tape.

See Illustration #1

b. The second step may be to use the tape as input and update the files that are on disk.

c. The third step may be to copy the newly created disk files to tape.

```
// JOB PAY-UPDATE
// EXEC P19HRD
// EXEC P21HRD
// EXEC P22HRD
/*
/&
```

CYCLE 1

```
// JOB PAYCHECKS
// EXEC P41HRD
// EXEC P42HRD
// EXEC P43HRD
/*
/&
```

CYCLE 3

```
// JOB SAVINGS BONDS
// EXEC P31HRD
// EXEC P32HRD
// EXEC P33HRD
// EXEC P34HRD
/*
/&
```

CYCLE 2

Illustration #2

2. Job Streams: We may have a job which is part of an application system. Let's again use the payroll application system for example. See Illustration #2

a. The first job of this system may be to update the payroll files.

b. The second job of the system may be to print U.S. Savings Bonds.

c. And finally, the third job may consist of several programs used to print payroll checks.

These jobs may be called cycles (this means a certain phase of the complete system. What happens when we have to run all three jobs in our payroll system at one time? See Illustration #2

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SEPARATE JOBS

```
// JOB PAY-UPDATE
// EXEC P19HRD
// EXEC P21HRD
// EXEC P22HRD
/*
/&

// JOB SAVINGS BONDS
// EXEC P31HRD
// EXEC P32HRD
// EXEC P33HRD
// EXEC P34HRD
/*
/&

// JOB PAYCHECKS
// EXEC P41HRD
// EXEC P42HRD
// EXEC P43HRD
/*
/&
```

A JOB STREAM
(PAY STREAM)

```
// JOB PAY-UPDATE
// EXEC P19HRD
// EXEC P21HRD
// EXEC P22HRD
/*
/&
// JOB SAVINGS BONDS
// EXEC P31HRD
// EXEC P32HRD
// EXEC P33HRD
// EXEC P34HRD
/*
/&
// JOB PAYCHECKS
// EXEC P41HRD
// EXEC P42HRD
// EXEC P43HRD
/*
/&
```

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Illustration #3

What we can do is stack these three jobs in our payroll system back to back. When we combine these three jobs we come up with what is called a job stream. The job stream is a series of jobs put together in one batch. This will enable you as an operator in a Data Processing Installation to run a series of jobs without having to load the card reader again, but rather to put them in the card stacker of the card reader all at one time.

See Illustration #3

JOB STREAM
(PAY STREAM)

```
// JOB PAY-UPDATE
// EXEC P19HRD
// EXEC P21HRD
// EXEC P22HRD
/*
/&
// JOB SAVINGS BONDS
// EXEC P31HRD
// EXEC P32HRD
// EXEC P33HRD
// EXEC P34HRD
/*
/&
// JOB PAYCHECKS
// EXEC P41HRD
// EXEC P42HRD
// EXEC P43HRD
/*
/&
```

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Illustration #4

Let's take a look at the amount of JCL you will be using to process the jobs in the make-believe payroll system. This is a tremendous amount of JCL, and you may be required as an operator to carry large stacks of JCL. There would be a good chance at some time that you could accidentally drop the JCL decks and they could become out of sequence. There is also a good chance that some of the JCL you would be carrying could be lost.

See Illustration #4

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```
// JOB PAYSTREAM
// EXEC PAYSTREAM
/&
```

(THE JCL ON THE LEFT OF THIS VUGRAPH REQUESTS THE JOB STREAM ON THE RIGHT FROM ITS LOCATION ON DISK.)

ON DISK
JOB STREAM (PAY STREAM)

```
// JOB PAY-UPDATE
// EXEC P19HRD
// EXEC P21HRD
// EXEC P22HRD
/*
/&
// JOB SAVINGS BONDS
// EXEC P31HRD
// EXEC P32HRD
// EXEC P33HRD
// EXEC P34HRD
/*
/&
// JOB PAYCHECKS
// EXEC P41HRD
// EXEC P42HRD
// EXEC P43HRD
/*
/&
```

Illustration #5

3. Disk JCL: A good solution to this problem is: Once the programmer creates the JCL, he can transfer it to magnetic media. The most commonly used media for this purpose is magnetic disk. When JCL is stored on disk it is called Disk JCL. This transferring to magnetic disk puts the JCL in machine readable language which requires little storage space. A library on disk like the program library can be established for the JCL in a Data Processing Installation. Another advantage besides reducing the amount of storage of JCL is you would be required to handle just a few JCL cards that will be used to request the job stream from disk; and still another advantage is speed. The card reader reads at a maximum of 1,000 cards per minute. The disk runs in terms of a thousand instructions a second and this JCL can be read from disk in a fraction of the time it would take to read them from a card reader. In the Army, the JCL for certain jobs are extremely long, so you can see how we can save time by putting the JCL on disk. By putting the JCL on disk we gain three benefits: See Illustration #5

a. We reduced the amount of JCL handling and reduced the chance of losing cards.

b. We saved valuable storage space by putting the JCL on magnetic disk.

c. We increased efficiency by saving time.

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```
// JOB SAVINGS BONDS                    (MEMORY REQUIREMENT)
// EXEC P31HRD..................... 14K
// EXEC P32HRD..................... 96K
// EXEC P33HRD..................... 80K
// EXEC P34HRD..................... 102K
/*
/&
```

COMPUTER

MEMORY
AVAILABLE

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Illustration #6

4. Running a job: Let's talk about running a single job on a computer that has 100K of memory available for processing a job. In our example of the payroll system, the job that is used to print savings bonds had four job steps (four programs). See Illustration #6

a. The first program requires 14K

b. The second program requires 98K

c. The third program requires 80K

The first three job steps can be ran since they require less than 100K. However, the complete job cannot be ran because the fourth program requires 102K. It requires more memory than the computer has available, which is 100K. If you have a computer that has 100K available for job processing, the programs (job steps) cannot require more than 100K.

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```
// JOB SAVINGS BONDS          (MEMORY REQUIREMENT)
// EXEC P31HRD.................14K  (LESS THAN 100K)
// EXEC P32HRD.................98K  (LESS THAN 100K)
// EXEC P33HRD.................80K  (LESS THAN 100K)
// EXEC P34HRD................100K (EQUAL TO 100K)
/*
/&
```

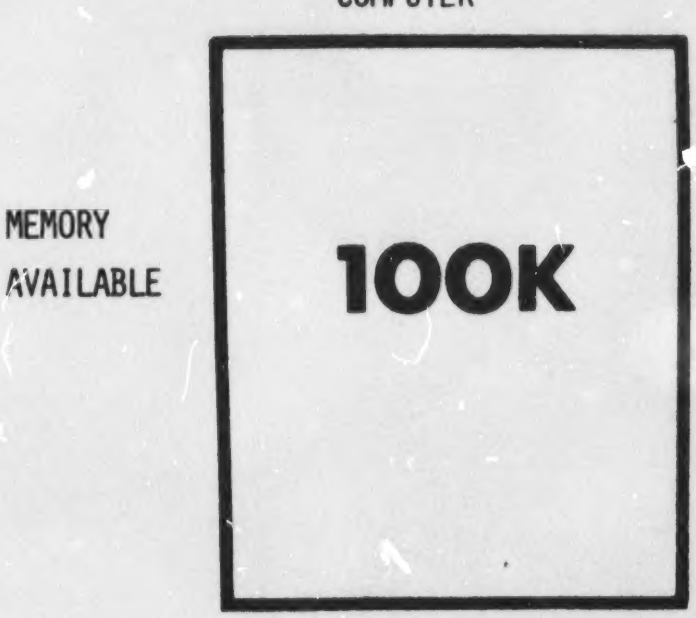

Illustration #7

When a programmer writes a program, he must consider how much memory space is available for processing that program. If he does this correctly, we may have a job that appears like this one. Now this complete job can be ran on the computer because all the job steps (programs) require processing memory which is equal to or less than 100K.

See Illustration #7

```
// JOB SAVINGS BONDS                (MEMORY REQUIREMENT)
// EXEC P31HRD.....................14K
// EXEC P32HRD.....................50K
// EXEC P33HRD.....................16K
// EXEC P34HRD.....................20K
/*
/&
```

COMPUTER

MEMORY AVAILABLE 100K

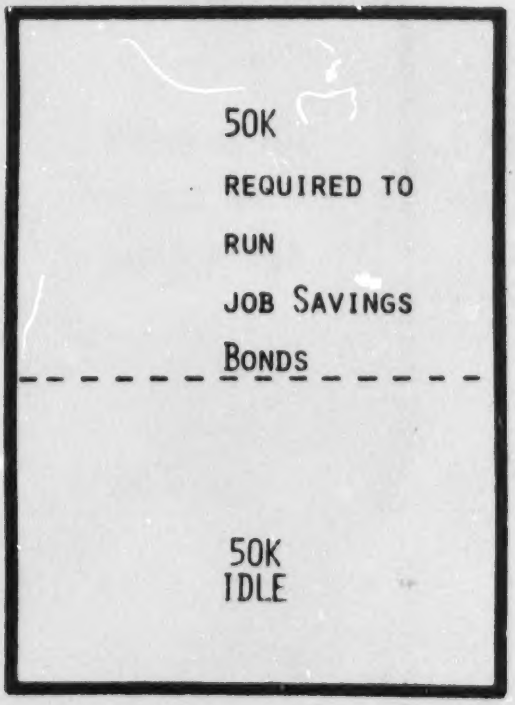

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Illustration #8

5. Multiprogramming: Let's say instead of the previous example, the programmer wrote the first program to run in 14K, the second requires 50K, the third requires 16K and the fourth job step (program) requires only 20K. We have 100K available in the computer but now the largest job step requires 50K. We can still run this job in the 100K, but we have 50K of memory that will not be needed. The 50K not being used by the program will be idle. This is no real problem since this job is the only job to be run.

See Illustration #8

```
// JOB SAVINGS BONDS
// EXEC P31HRD......14K
// EXEC P32HRD......50K
// EXEC P33HRD......16K
// EXEC P34HRD......20K
/*
/&
```

```
// JOB TANK MAINTENANCE
// EXEC P51HRD.....48K
// EXEC P52HRD.....50K
// EXEC P53HRD.....16K
/*
/&
```

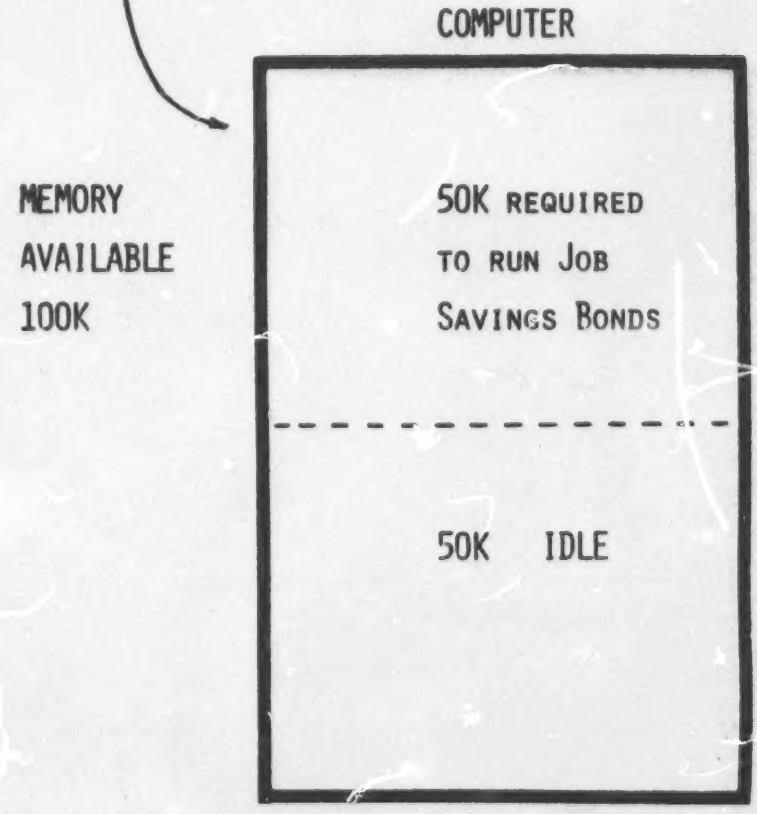

Illustration #9

But this introduces an interesting question. What happens if we had another job that needed to be ran? For example: See Illustration #9

a. The first job step requires 48K

b. The second job step requires 50K

c. The third job step requires 16K

You can see that this job can be ran on the computer because the largest job step requires only 50K, which is less than 100K. You can also see that the largest job step is equal to the amount of memory that will not be used when the U.S. Savings Bonds job is being ran.

```
// JOB SAVINGS BONDS
// EXEC P31HRD
// EXEC P32HRD
// EXEC P33HRD
// EXEC P34HRD
/*
/&
```

```
JOB TANK MAINTENANCE
// EXEC P51HRD
// EXEC P52HRD
// EXEC P53HRD
/*
/&
```

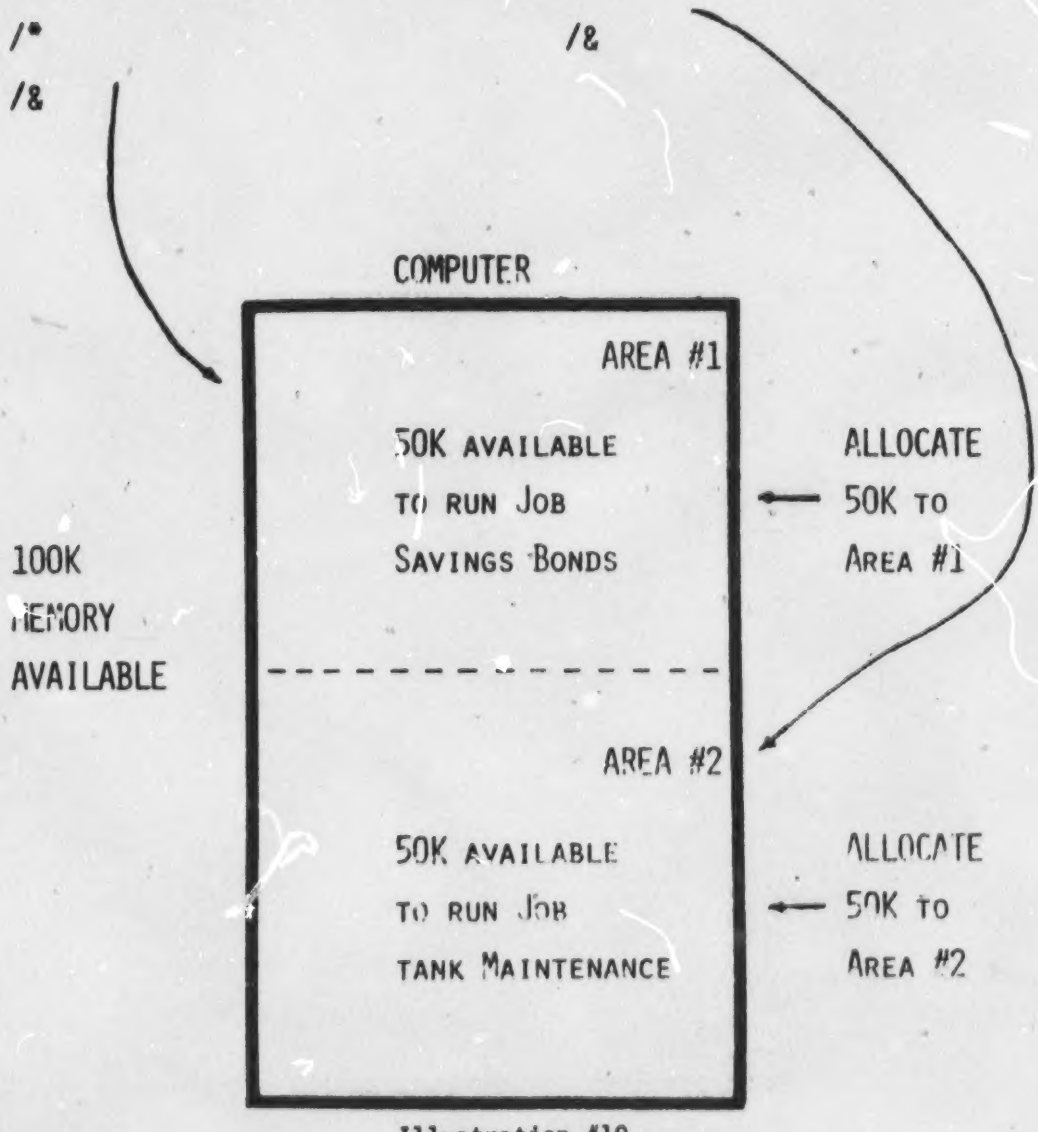

Illustration #10

Why can't we load the second job in the area that is not being used by the Savings Bonds job?

We can, but first we have to let the computer know that we want it to divide the available memory into two areas. This is called allocating memory on a computer. The reason you allocate memory is to insure that when you are running two jobs in a computer, these jobs don't try to get the same memory area to run its program. See Illustration #10

Now we can load Savings Bonds in memory Area #1, and tank maintenance in memory Area #2. This technique of running more than one job on the computer is called multiprogramming.

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```
// JOB SAVINGS BONDS
// EXEC P31HRD
// EXEC P32HRD
// EXEC P33HRD
// EXEC P34HRD
/*
/&
```

```
// JOB TANK MAINTENANCE
// EXEC P51HRD
// EXEC P52HRD
// EXEC P53HRD
/*
/&
```

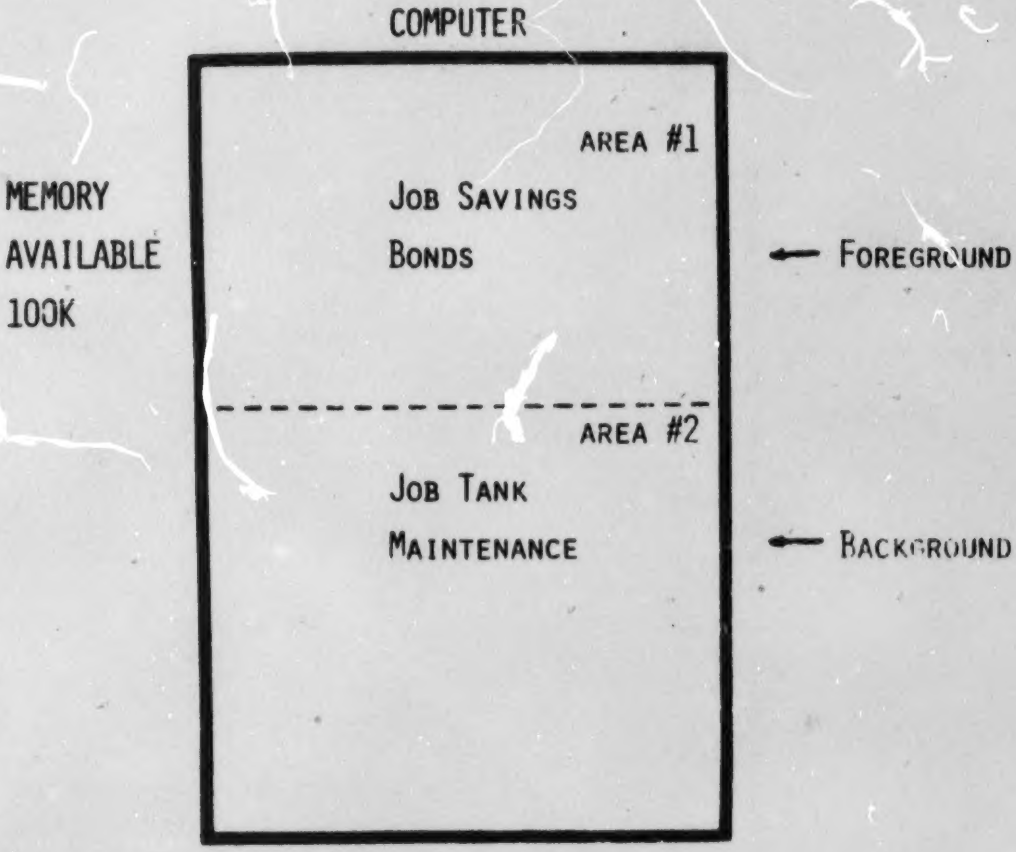

Illustration #11

6. Area Identifiers: How do we know what area the jobs are in? The solution to this is the use of identifiers. At the school instead of calling them Area #1 and Area #2, we call them Background and Foreground. We use these identifiers to identify the area when we speak about them or communicate with them. In Background, the job we loaded is job maintenance which is used to account for maintenance for our tank equipment. The job in foreground is job Savings Bonds.

See Illustration #11

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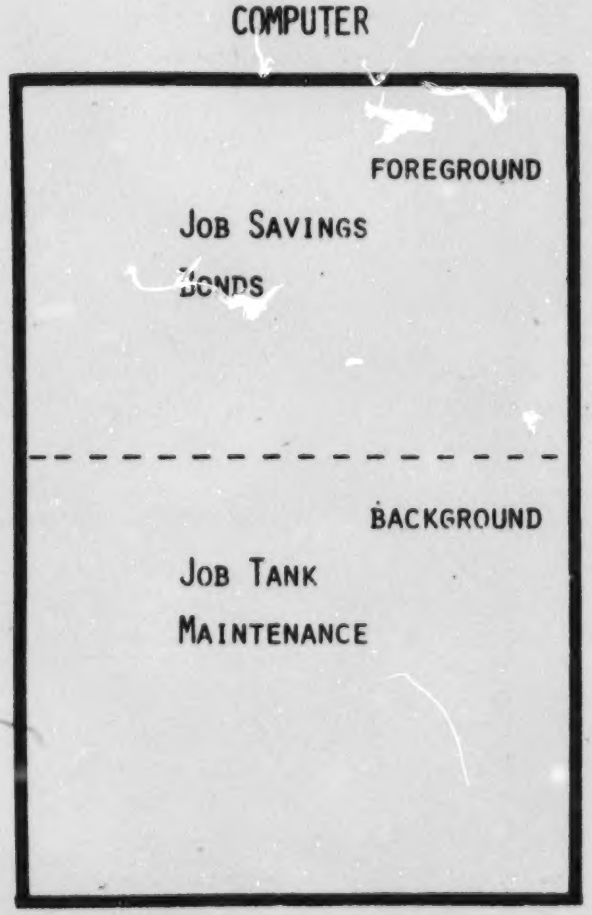
```
// JOB SAVINGS BONDS
// EXEC P31HRD
// EXEC P32HRD
// EXEC P33HRD
// EXEC P34HRD
/*
/&
```

```
// JOB TANK MAINTENANCE
// EXEC P51HRD
// EXEC P52HRD
// EXEC P53HRD
/*
/&
```



MEMORY AVAILABLE 100K

FOREGROUND HAS PRIORITY OVER BACK-GROUND

Illustration #12

7. Area Priorities: If you remember the example of card to tape, given in the block of instruction on Channels, Control Units and Physical Addresses, that during the time the card reader is reading the card and the tape drive is writing the data, the CPU was idle. This is when one job will be doing its processing while the other job is waiting for an I/O operation to be completed. Although the computer appears to run both jobs at the same time, actually, the result is that the computer runs one job for a fraction of a second, then runs the other job for another fraction of a second. What happens if job maintenance doesn't require numerous I/O functions and will not allow job Savings Bonds to process. (This can happen when a job requires a lot of CPU activity). Job Savings Bonds will be waiting for processing as a result. Let's say you were told that Savings Bonds has to be finished very soon but both jobs take a long time to process. Job maintenance will not let job Savings Bonds run so we have to set priorities. Job Savings Bonds needs to be completed as soon as possible so it has priority over job maintenance. Background will be processing when foreground is waiting for a card to be read or when the tape drive is writing records on tape. If both background and foreground needs the CPU at the same time, foreground has the priority and will use the CPU first.

See Illustration #12

8. Let's review what you have learned in Concepts of Computer Processing.

a. We mentioned that a job can be a one-step (program) or could be more than one step.

b. We discussed that Job Streams are used when more than one job is needed to meet the requirements of the Data Processing Installation.

c. We can eliminate the handling of a large batch of JCL cards by using Disk JCL. All we need is a few JCL cards to request the JCL for the jobs from disk.

d. We discussed that a program's memory requirement for processing cannot be greater than the memory area available in the computer.

e. We can run two jobs at the same time resulting in multiprogramming. We can insure that the proper amount of memory is available for each job by allocating memory.

f. You learned that area identifiers are used to allow us to communicate with the separate jobs.

g. You learned that if a job has a higher priority than another job such as our job Savings Bonds and job maintenance, we can say, the area or partition (we call them partition at the school) which is running the more important job has a higher priority. The other job will use the computer when the job with the higher priority is waiting for I/O operations to be completed.

9. If you have grasped the basic concepts in this lesson, you will have a good foundation for your introduction to the Disk Operating System (DOS) which you will study in later lessons.

SELF EVALUATION

1. True or False. A job step consists of more than one program _____.

2. True or False. Jobs stacked back-to-back in one batch is a job stream _____.

3. True or False. JCL stored in a library on magnetic disk is called Disk JCL _____.

4. True or False. A huge amount of cards are required to pull job streams from Disk _____.

5. True or False. If a program requires more than the amount of memory in the computer it still can be ran _____.

6. True or False. Multiprogramming is the technique of running one job at a time _____.

7. From the list below, select the advantages of Disk JCL.

   a. Saves storage space

   b. Less JCL for the operator to handle

   c. You can run more than one job at a time

   d. Less memory is required to run a job

   e. Transfer speed from disk is faster than from the card reader

8. True or False. Memory area identifiers are used to identify JCL _____.

9. True or False. All memory areas must have the same priority _____.

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ANSWER KEY

1. False
2. True
3. True
4. False
5. False
6. False
7. a., b., e.
8. False
9. False

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01-01-30

US ARMY INSTITUTE OF ADMINISTRATION
Fort Benjamin Harrison, Indiana 46216

APPLICATION PROGRAMS

Prepared for: Computer/Machine Operator Course

Prepared by: Hardware Division, Data Processing Department

March 1979

STUDENT NAME: _____

CLASS NO. _____

FOR INSTRUCTIONAL PURPOSES ONLY

CHAPTER 8

APPLICATION PROGRAMS

A. INTRODUCTION: This chapter introduces you to the steps taken by the programmer to create a program. This chapter also includes material associated with programs that you will need to learn before beginning later lessons.

B. OBJECTIVE: The objective of this block of instruction is to provide you with the necessary information needed to:

1. Identify an application program.
2. Identify the steps taken by the programmer to create a program.
3. Identify a logical unit and a file name.
4. Identify a program library.
5. Identify a program message.
6. Identify a control card.

C. TRAINING AIDS:

None.

D. TRAINING:

1. Application Program: An application program is a program designed to solve a particular problem for a specific application.

2. Creation of a Program: When it is decided that a program is needed to solve a particular problem, the programmer has four basic steps that must be accomplished before the program is ready for processing.

These steps are:

a. Define the problem
b. Write the program
c. Test the program
d. Prepare documentation

(1) Define the problem: The programmer will consider what the program is to accomplish, what the output is to be and what input is needed to get the desired results.

(2) Write the program: After the programmer has decided what the input and output will be, he will consider what the program must do to get the output and will begin writing the program.

(3) Test the program: Once the program is written the programmer will test the program to insure it produces the correct output.

(4) Prepare documentation: Preparing documentation is an extremely important step. The programmer should prepare documentation throughout the creation of the program but unfortunately this is rarely done. Documentation is any information that will be needed to process and maintain the program. Once this step is complete, the program will be ready to process.

3. Logical Units and File Names: During the writing of the program the programmer is required to describe all files the program will use during processing. This is a section of a program where a file was described:

```
FILE-CONTROL.
    SELECT E19HRD  <----------(FILE NAME)
        ASSIGN TO UT-S-SYS006.  <----------(LOGICAL UNIT)
    SELECT CARD-FILE
        ASSIGN TO UT-S-SYS016.
DATA DIVISION
FILE SECTION.
FD  E19HRD
    BLOCK CONTAINS 1 RECORDS
    RECORD CONTAINS 80 CHARACTERS
    LABEL RECORDS ARE STANDARD
    DATA RECORDS ARE TAPE-REC.
```

At this time he must give each file a unique name. This name will be used by the programmer when he references the file. The file name is simply a name for a file. Each file is also assigned a logical unit. The logical unit is where the file resides.

4. Program Libraries: After a program is developed it is stored with the other programs being used in the installation. Although programs can be stored on other media, normally they will be stored on magnetic disk. The area on disk where groups of programs are stored are called program libraries.

5. Program Messages: The programmer may find it necessary that certain information be provided to the operator during the processing of a program. The program can be written so a message to the operator can be displayed on an inquiry device. This message is called a program message since it is issued by the program. This message can be information only or it may require the operator to respond. The operator may be required to key in information to the program through the inquiry device or perform some other type of action.

6. Control Cards: During the development of the program, the programmer will consider several options* needed to make the program satisfy different needs of the user. One way the programmer can do this is by writing the program to use a control card. The control card is a punched card that will contain information (possibly in code) which will let the program know what options are required or what will be provided to the program. In general terms, the control card gives the Data Processing Installation the ability to choose what options are needed to satisfy the user's needs.

E. SUMMARY: In this chapter you have learned the steps taken to create a program. These are define the problem, write the program, test the program and prepare documentation. Also, we discussed terms which you will see in later lessons.

F. CONCLUSION: Before continuing on to the next chapter answer the questions in the self-evaluation quiz to insure you have met the objectives of this chapter. Following chapters will reference the material presented in this chapter.

*The predetermined information or codes and corresponding options will be written into the program during program development.

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SELF-EVALUATION QUIZ

1. List the steps of program development in the area provided below.

   a. _____

   b. _____

   c. _____

   d. _____

2. From the list below select the (2) statements that define the term application program.

   a. A community service program

   b. Program designed for a specific application

   c. A program designed to solve a particular problem

   d. PT program

3. A program message is (Choose 2 answers)

   a. Message from a program

   b. Message from the computer

   c. Message giving information or requiring operator action

   d. Message from the operator

4. A file name is:

   a. Name given to a file by the programmer

   b. Name of a volume

   c. Name of a record

5. A program library is: (Choose 1 answer)

   a. Place where books are stored

   b. Area where tapes are stored

   c. Area where programs are stored

   d. Area where disks are stored

6. A control card is: (Choose 1 answer)

   a. Card used to issue program messages

   b. Card used to identify files

   c. Card used to tell a program what options are required

   d. Card used to control libraries

7. A logical unit is: (Choose 1 answer)

   a. A physical unit

   b. Where a file resides

   c. Is the same as a file name

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SOLUTIONS

	SOLUTION	REFERENCE
1.	a. Define the Problem	2
	b. Write the Program	
	c. Test the Program	
	d. Prepare Documentation	
2.	b., c	1
3.	a., c.	5
4.	a.	3
5.	c.	4
6.	c.	6
7.	b.	3

DATA REPRESENTATION

STUDENT NOTES AND PRACTICAL EXERCISE

1. Decimal Number System (Base 10):

   a. Ten digits:

   b. Positional Values:

2. Binary (base 2):

   a. Two digits:

      (1) On - bit - 1

      (2) Off - no bit - 0

   b. Why used in electronic DP:

   c. Positional values:

   d. Conversion:

      (1) Convert decimal to binary:

100	10	1
		4
	1	4
	2	6
	6	3

32	16	8	4	2	1
			.	.	.
		.	.	.	.
	.	.	.	.	.
.	.	.	.	.	.

ANNEX A

(2) Convert binary to decimal:

32	16	8	4	2	1	100	10	1
			1	0	1			.
	1	0	0	0	1		.	.
		1	0	1	1		.	.
1	1	1	0	0	1		.	.

e. Addition:

(1) 0 + 0 =

(2) 1 + 0 or 0 + 1 =

(3) 1 + 1 =

(4) 1 + 1 + 1 =

(5) Perform the following addition operations and convert the answers to their decimal equivalents.

(a) 101 +001 ... ( )

(b) 1000 +1001 .... ( )

(c) 1011 +1001 .... ( )

(d) 1111 +0011 .... ( )

(e) 01110 +11011 ..... ( )

(f) 1001100 + 101011 ..... ( )

f. Subtraction:

(1) Complement of Subtrahend

(2) Addition Operation

(3) High Order Carry (+ sign)

(4) Subtract in binary and convert the answers to their decimal equivalents:

(a) Problem

```
  101
- 011
 ... ( )
```

(b) Problem

```
  11100
-   10
 ..... ( )
```

(c)
```
  1101011
-1011110
 ....... ( )
```

(d)
```
  1111
- 0011
 .... (  )
```

g. Multiplication:

h. Division:

i. Binary Coded Decimal (BCD):

(1) 4-bit binary field for each decimal numeric character.

(2) Convert decimal to BCD:

DECIMAL			BCD		
100	10	1	8421	8421	8421
		7			....
	1	5		....	....
	7	6		....	....
4	2	3	....	....	....

(3) Convert BCD to decimal and binary:

BCD		DECIMAL		BINARY					
8421	8421	10	1	64	32	16	8	4	2	1
0001	0010	.	.				.	.	.	.
0100	0010	.	.	.	.		.	.	.	.
0110	0011	.	.	.	.		.	.	.	.
1000	1000	.	.	.	.		.	.	.	.

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3. Octal Number System (base 8):

a. Eight digits:

b. Positional values:

c. Conversion:

(1) Convert decimal to octal:

10	1	8	1
	6		.
1	8	.	.
4	6	.	.
6	3	.	.

(2) Convert octal to decimal:

8	1	10	1
1	2	.	.
1	8	.	.
3	2	.	.
7	6	.	.

d. Addition:

Solve the following octal addition problems and convert the answers to their decimal equivalents:

(1) 2 +5 . ( )

(2) 12 + 7 .. ( )

(3) 52 +66 ... ( )

(4) 64 31 +72 ... ( )

e. Binary Coded Octal:

(1) Three bit field per Octal digit.

(2) Converaion

(a) Convert Octal to Binary Coded Octal:

8	1	4 2 1	4 2 1
	6		. . .
1	4	. . .	. . .
2	6	. . .	. . .
4	7	. . .	. . .

(b) Convert Binary Coded Octal to Octal and then to its decimal equivalent:

4 2 1	4 2 1	8 1	10 1
0 0 1	0 0 1	. .	. .
0 0 1	1 0 1	. .	. .
1 0 1	1 1 0	. .	. .
1 1 1	1 0 0	. .	. .

(c) Convert Octal to Decimal and then to Binary Coded Decimal:

512	64	8	1	1000	100	10	1	8421	8421	8421	8421
		2	3			.	.			....	....
	1	2	7			.	.			....	....
	7	6	0		.	.	.		....	....	....

4. Hexadecimal Number Systems (base 16):

a. Sixteen symbols:

(1) Ten digits

(2) Six letters

b. Positional valves:

c. Types of computers using this system:

d. Conversion:

(1) Convert the following hexadecimal numbers to decimal:

256	16	1	1000	100	10	1
		D			.	.
	A	F		.	.	.
3	A	C		.	.	.
A	3	6	.	.	.	.

(2) Convert the following hexadecimal numbers to decimal and then to straight binary:

256	16	1	100	10	1	256	128	64	32	16	8	4	2	1
		E		.	.						.	.	.	.
	A	9	.	.	.		.	.	.	.	.	.	.	.
	F	3	.	.	.		.	.	.	.	.	.	.	.
1	C	6	.	.	.	.	.	.	.	.	.	.	.	.

e. Addition: Perform the following addition problems in hexadecimal and convert the answers to decimal equivalents:

8	A6	B4	DE
+ 5	+45	+6E	+CF
. ( )	.. ( )	... ( )	... ( )

f. Binary Coded Hexadecimal:

(1) Four bit field per hexadecimal digit:

(2) Conversion:

(a) Convert the following Binary Coded Decimal numbers to decimal and then to hexadecimal:

8421	8421	8421	8421	1000	100	10	1	4096	256	16	1
		1000	0101			.	.			.	.
	0010	0111	0110		.	.	.		.	.	.
0001	0111	0101	1000	.	.	.	.		.	.	.
0111	0100	0011	0101	.	.	.	.	.	.	.	.

(b) Convert the following Decimal numbers to Hexadecimal and then to Binary Coded Hexadecimal.

100	10	1	256	16	1	8421	8421	8421
		3			.			....
	9	7		.	.		....	....
5	6	9	.	.	.	....	....	....
7	0	3	.	.	.	....	....	....

2.10

5. Extended Binary Coded Decimal Interchange Code (EBCDIC):

a. Zoned Decimal Format (Alpha):

(1) A-I

(2) J-R

(3) S-Z

(4) Special Characters

(5) Indicate the following values in EBCDIC Zoned Decimal Format:

	8421	8421
A =	....	....
K =	....	....
T =	....	....
H =	....	....

b. Parity Check:

(1) Lost or gained bits

(2) Kinds:

(a) Even: The number of "1" bits (in the 8 bit configuration) is added. If the number of "1" bits is odd, another "1" bit is placed under the parity bit position to make the entire bit configuration even. Otherwise, an "0" bit is added to the 8 bit configuration.

(b) Odd: The number of "1" bits (in the 8 bit configuration) is added. If the number of "1" bits is even, another "1" bit is placed under the parity bit position to make the entire bit configuration odd. Otherwise, an "0" bit is added to the 8 bit configuration.

(3) Number of bits needed to represent one character of data:

(4) Specify parity (0 or 1) to make each of the following characters valid under odd-bit parity:

P	8421	8421	P	8421	8421
.	1100	0100	.	0110	0001
.	1110	1000	.	1001	0100
.	1101	0010	.	1110	1011

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c. Zoned Decimal Format (numeric): The sign appears in the ZONE portion of the low order byte (the rightmost 8 bit configuration); the ZONE portion of all other bytes appear with "unsigned" representation.

(1) Convert the following Decimal Values to Zoned Decimal and to Hexadecimal:

DECIMAL	ZONED DECIMAL	HEXADECIMAL
23	.....	.....
	. .	. .
+ 175	.....	.....
	. .	. .
- 329	.....	.....
	. .	. .
- 871	.....	.....
	. .	. .
+ 7		.....
		. .

(2) Translate the following hexadecimal character string (7D is an apostrophe and 40 is a blank or space):

E3C8C1E37DE240C1D3D340C6D6D3D2E2

d. Packed Decimal Format:

(1) Neither alphabetic nor alphanumeric data "can" be packed.

(2) Method:

(a) Format or represent the data in Zoned Decimal.

(b) Strip all the "zones" except for the low order byte.

(c) Move the sign to the old "digit" portion of the low order byte.

(d) Packing occurs from right to left.

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(3) Convert the following numeric values to Packed Decimal & to Packed Hexadecimal formats:

DECIMAL	PACKED DECIMAL (EBCDIC) PACKED HEXADECIMAL	
148	.....	.....
	. .	. .
+ 53	.....	.....
	. .	. .
- 99	.....	.....
	. .	. .

e. To determine the (packed) length of a packed numeric field:

(1) If, in decimal, the field length is <u>even</u>, DIVIDE the decimal field length by 2 and then ADD 1; or:

$$\frac{n}{2} + 1 = x$$

Where n = the size of the decimal field (in bytes), and

x = the number of bytes which will result from packing.

(2) If, in decimal, the field length is odd, ADD 1 to the decimal field length, then DIVIDE by 2; or:

$$\frac{n + 1}{2} = x$$

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6. Situation -

a. The Installation MISO has issued a blanket directive that all DPIs on the installation will conserve file space by packing all applicable data on all files. The Director of your DPI is not familiar with packing and asks you, as the Chief of his Systems/Programming Division, to analyze the following abbreviated Master Inventory File and determine the total number of bytes which can be saved by packing.

Field	No. Characters/Type		Sample Data
FSN	11	N	33136298032
Nomenclature	10	A/N	M1A2 RIFLE
Julian Date	4	N	4284
Commodity Code	2	A	AB
Customer Code	3	N	716

b. The DPI Director is still skeptical and asks you to empirically show him some examples of how the data would actually look in packed format. Therefore, using the appropriate sample data provided in the abbreviated Master Inventory File (para 6.a.above) you show him how the data will appear in Zoned Decimal, in Packed Decimal, and in Packed Hexadecimal.

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7. The following byte configuration has been extracted from a "dump"; alphabetic information is being represented. Convert the data from the dump to Zoned Decimal (EBCDIC) and then to the equivalent English interpretation:

DUMP extract: 4040D5C1 D4C54040

Zoned Decimal:

Interpretation:

8. The following byte configurations have been extracted from a "dump"; numeric information is being represented. Translate each byte configuration as indicated per each problem:

a. DUMP Extract: F1F9F7F2

Zoned Decimal:

Interpretation:

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b. DUMP Extract: 01972C00

Packed Decimal:

Interpretation:

c. DUMP Extract: 000007B4

Binary:

Interpretation:

TWO-FINGER ARITHMETIC

The decimal system, the arithmetic system we are so familiar with, is not particularly suited to the operation of electronic calculators and computers.

The decimal system uses ten distinct digits - 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. But, electronic calculators and computers are made up of switching devices, such as diodes, transistors, and magnetic cores, that have only two definite stable states. They are either ON or OFF, conducting or not conducting, or magnetized or de-magnetized. Practically, therefore, these devices can be made to represent only two different things.

For example, we can let the OFF-condition represent a zero, and the ON-position represent the one. But we have no simple way of representing the digits 2 to 9.

ON
(MAGNETIZED)

OFF
(DEMAGNETIZED)

Therefore, in these computers, we utilize the binary number system, with which we can represent any number by using only the digits 0 and 1.

Actually, we might be using the binary system in everyday arithmetic today if man had evolved with only two fingers instead of ten. The decimal system undoubtedly developed as a result of man's earliest attempts to count on his fingers.

Let us see how both systems work, and how they compare. The decimal system, as we have said, uses ten distinct digits - 0 to 9. With these digits we can represent any value from 0 to 9 in a single digit position, the units position.

			Units
			0
			1
			2
			3
			4
			5
			6
			7
			8
			9

When we have reached 9, we find that we do not have another distinct symbol for the value of ten. So we carry a 1 into a second digital position, the tens position.

		Tens	Units
		1	0
		1	1
		1	2
		.	.
		.	.
		.	.
		.	.
		.	.
		9	9

By using all the digit symbols in both the units and tens position, we can now represent any value from 0 to 99.

By increasing to more and more digit positions (100s, 1000s, and so on) we can represent any number with the decimal system.

Actually what we have done is this. In each new digit position we have increased the value of our number symbols ten times. For example, a 3 in the tens position is worth 10 times as much as in the units position, and in the 100s position the 3 is worth 10 times what it was worth in the tens position, and so on.

1000s	100s	10s	1s
			3
		3	0
	3	0	0
3	0	0	0

The binary system works on the same principle, except this time we have only two different digits to work with, 0 and 1. To write the value zero we can write a 0. To indicate the value one, we can write a 1 (one).

			Units
			0
			1

Now we have no single symbol to represent the value of two in the units position. So, while we did not have to carry until we reached 9 in the decimal system, we are already forced to carry in the binary system. In the binary system, our next digit position is called the two's position instead of the tens position.

		2s	Units
		1	0
		1	1

Binary		Decimal
10	=	2
11	=	3

A two is represented by a digit 1 in the two's position; a three by the digit "one" in the two's position and also in the units position. Again we have run out of digits, and must go to a new digits position to represent the value of four.

4s		2s	Units
1		0	0

Binary		Decimal
100	=	4

Note that, while in the decimal system each new digits position has ten times the value of the preceding one, in the binary system each new digit position has two times the value of the preceding one.

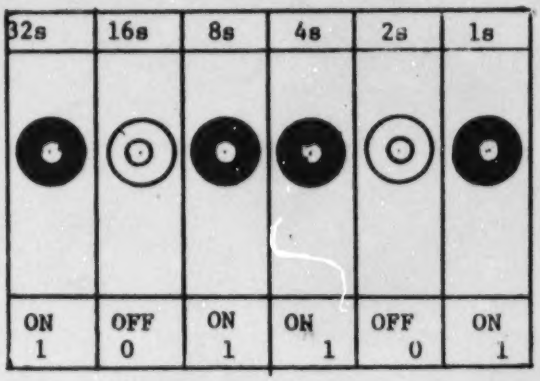
32s	16s	8s	4s	2s	1s
1	0	1	1	0	1

The decimal equivalent of the binary number shown in the above illustration is determined as follows:

1 in the 1's position = 1
0 in the 2's position = 0
1 in the 4's position = 4
1 in the 8's position = 8
0 in the 16's psition = 0
1 in the 32's paition = 32
101101 = 45

So, the binary number 101101 represents 45 in the decimal system.

You can see that this number could very easily be represented by six magnetic cores where OFF has a value of zero, and ON has a value of one.



This two-finger arithmetic is the heart of electronic digital computer design. It is the binary system that makes possible the high speed and usefulness of modern electronic digital computers.

Actually, it is possible to develop arithmetic systems based on any number of digit symbols, other than two or ten.

We, however, use the decimal system because we have ten fingers, and the digital computers use the binary system because their electronic components have only two possible Bi-state positions - ON and OFF.

OCTAL-DECIMAL CONVERSION

Octal	Decimal	Octal	Decimal	Octal	Decimal	Octal	Decimal
0	0	400	256	1000	512	1400	768
10	8	410	264	1010	520	1410	776
20	16	420	272	1020	528	1420	784
30	24	430	280	1030	536	1430	792
40	32	440	288	1040	544	1440	800
50	40	450	296	1050	552	1450	808
60	48	460	304	1060	560	1460	816
70	56	470	312	1070	568	1470	824
100	64	500	320	1100	576	1500	832
110	72	510	328	1110	584	1510	840
120	80	520	336	1120	592	1520	848
130	88	530	344	1130	600	1530	856
140	96	540	352	1140	608	1540	864
150	104	550	360	1150	616	1550	872
160	112	560	368	1160	624	1560	880
170	120	570	376	1170	632	1570	888
200	128	600	384	1200	640	1600	896
210	136	610	392	1210	648	1610	904
220	144	620	400	1220	656	1620	912
230	152	630	408	1230	664	1630	920
240	160	640	416	1240	672	1640	928
250	168	650	424	1250	680	1650	936
260	176	660	432	1260	688	1660	944
270	184	670	440	1270	696	1670	952

OCTAL-DECIMAL Conversion, continued

Octal	Decimal	Octal	Decimal	Octal	Decimal	Octal	Decimal
300	192	700	448	1300	704	1700	960
310	200	710	456	1310	712	1710	968
320	208	720	464	1320	720	1720	976
330	216	730	472	1330	728	1730	984
340	224	740	480	1340	736	1740	992
350	232	750	488	1350	744	1750	1000
360	240	760	496	1360	752	1760	1008
370	248	770	504	1370	760	1770	1016

SUMMARY OF NUMERIC DATA REPRESENTATIONS

DECIMAL	BINARY	BCD	OCTAL	BCO	HEXADECIMAL	BCH
1	0001	0000 0001	1	000 001	1	0000 0001
2	0010	0000 0010	2	000 010	2	0000 0010
3	0011	0000 0011	3	000 011	3	0000 0011
4	0100	0000 0100	4	000 100	4	0000 0100
5	0101	0000 0101	5	000 101	5	0000 0101
6	0110	0000 0110	6	000 110	6	0000 0110
7	0111	0000 0111	7	000 111	7	0000 0111
8	1000	0000 1000	10	001 000	8	0000 1000
9	1001	0000 1001	11	001 001	9	0000 1001
10	1010	0001 0000	12	001 010	A	0000 1010
11	1011	0001 0001	13	001 011	B	0000 1011
12	1100	0001 0010	14	001 100	C	0000 1100
13	1101	0001 0011	15	001 101	D	0000 1101
14	1110	0001 0100	16	001 110	E	0000 1110
15	1111	0001 0101	17	001 111	F	0000 1111
16	10000	0001 0110	20	010 000	10	0001 0000

APPENDIX C

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EXTENDED BINARY CODED DECIMAL INTERCHANGE CODE (EBCDIC)

		84218421
Alphabetic Data	A	11000001
	B	11000010
	C	11000011
	D	11000100
	E	11000101
	F	11000110
	G	11000111
	H	11001000
	I	11001001
	J	11010001
	K	11010010
	L	11010011
	M	11010100
	N	11010101
	O	11010110
	P	11010111
	Q	11011000
	R	11011001
	S	11100010
	T	11100011
	U	11100100
	V	11100101
	W	11100110
	X	11100111
	Y	11101000
	Z	11101001
Numeric Data	0	11110000
	1	11110001
	2	11110010
	3	11110011
	4	11110100
	5	11110101
	6	11110110
	7	11110111
	8	11111000
	9	11111001
	Blank	01000000

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APPENDIX C

	HOLLERITH CODE	ALPHA INFO	NUMERIC INFO	BINARY REPRESENTATION
HEX C	12 ZONE PUNCH	A - I	PLUS SIGN	1100
HEX D	11 ZONE PUNCH	J - R	NEGATIVE SIGN	1101
HEX E	0 ZONE PUNCH	S - Z	N/A	1110
HEX F	NO ZONE PUNCH	N/A	Unsigned	1111

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